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THE UNIVERSITY OF ALBERTA

The Potential for Sino-Canadian Joint Ventures in Beef Production

by

Ron E. Gietz

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

IN

AGRICULTURAL ECONOMICS

Rural Economy

EDMONTON, ALBERTA

Spring 1988

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled The Potential for Sino-Canadian Joint Ventures in Beef Production submitted by Ron E. Gietz in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE in AGRICULTURAL ECONOMICS.

Apedaile

Supervisor

汤杰 (Tang Jie)

A.W. Anderson

Date October 13, 1987

Abstract

The potential for Sino-Canadian joint ventures in in beef-production between the Heilongjiang General Bureau of State Farms and unspecified interests in Canada was examined. A cash-flow investment-analysis model of a hypothetical joint venture in export-oriented beef production was developed as a systems analysis tool. The model was based on a vertically integrated beef-production system to be located on the the Three Rivers Plain region of eastern Heilongjiang province, Peoples Republic of China. The proposed beef-production system involves adaptation of western technology to local conditions. The model is of an electronic spreadsheet format, and is subdivided into components of the vertically integrated system. Transfer prices were employed as a mechanism to permit the study of individual components. The model incorporates improvements in technological coefficients over time. It is designed to be operable on IBMpc compatable equipment, and to be applicable generally to the study of the financial performance of large, vertically integrated projects involving technology transfer. Model design and parameters were based on information collected in China and Canada.

Results of the Base Scenario of the investment-analysis model indicate an internal rate of return for a joint venture in beef-production of over 20%. Due to a high initial capital outlay, and biological delays inherent in the development of a large beef herd, the enterprise is not profitable until its sixth year and payback period is at least eight years. Sensitivity analysis demonstrated that results are more sensitive to financial than to technological assumptions. Several experiments were conducted, testing changes in assumptions relating to system design and financial environment.

Based on results of the analysis, and on supplementary information collected on the topic, it was determined that there was potential for Sino-Canadian joint ventures in beef-production. However, the special nature of beef-production technology transfer necessitates long term stability and commitment by both partners to a joint venture.

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I. Introduction

A. TOPIC

Economic reforms initiated in 1978 have helped narrow the gap in development between China and the western world. "Catching up to the West is exactly what Mr. Deng Xiaoping is ambitous for his country to achieve," and these aims are being pursued with a "set of policies strikingly similar to those that have transformed South Korea and Taiwan and that have enabled Japan to become the only country anywhere to catch up to the west"[1]. In the context of a rapidly evolving polity and economy, the possibility of mutually beneficial business ventures among Chinese and foreign interests is emerging.

Nowhere have the recent reforms had more impact than in the Chinese countryside (Parker,1987). This is the case in Heilongjiang province of northeastern China, where the state farm system, which plays an important role in the agriculture of that province, is undergoing substantial reform (Chung and DeBoer,1983). Diversification of a primarily grains-based economy is a principal goal of the Heilongjiang General Bureau of State Farms, both for economic and agronomic reasons. A diversification strategy with emphasis on light industry and food processing has been abetted by a large and growing number of commercial relationships with western firms.

The livestock sector, and particularly the beef industry, is one of the least developed components of the state farm system (See Chapter III.), despite the existence of underutilised and unutilised resources suited to beef production. The existence of a well developed beef industry in similar agroclimatic regions of western Canada, most noteably in Heilongjiang's sister province of Alberta, suggests that the potential may exist for technology transfer in beef-production between the two regions.

This thesis explores the potential for commercially based technology transfer in the beef industry between Canada and China, based on the principle of mutual benefit advocated in post-1978 Chinese political proclamations (Ho and Huenemann,1984). Specifically, the financial feasibility of Sino-Canadian joint ventures in beef production is examined.

---

[1] Parker, John. "China's Economy" **The Economist**. August 1, 1987. p 49.

B. PURPOSE

The purpose of the research project reported in this thesis was to determine the potential for joint ventures in beef production between interests in Heilongjiang and Alberta, taking into account all aspects of the establishment and operation of a vertically integrated beef-production enterprise in eastern Heilongjiang. Particular emphasis was placed on the financial prospectus of such a beef system.

C. OBJECTIVES

The objectives of the study were:

1. to design PC-compatable systems analysis tools specific to the beef-production problem, but potentially with general applications in project analysis.
1. to measure the financial feasibility of a joint venture in beef production under different assumptions of technology, market prices, exchange rates, and other variable factors.
2. to ascertain the sensitivity of project viability to various changes in economic and non-economic assumptions.
3. to determine the probable distribution of benefits to both Chinese and Canadian interests, by addressing the issues of economic viability and distribution of benefits between the two parties.

D. OVERVIEW

A systems-oriented cash-flow model of a hypothetical, export-oriented enterprise in vertically integrated beef-production was developed, encompassing all stages of production, from forage to marketing of processed beef products. The general model of a beef-production system was then refined to represent the case of a commercial joint venture between the Heilongjiang General Bureau of State Farms and unspecified Canadian interests. The modeled system is based on a location in the Hongxinglong sub-bureau, and on technical and financial information collected in Canada and China.

Environmental factors acting on the hypothetical beef-production system - factors that are likely to affect the system's feasibility - are described early in the thesis. Particular emphasis is placed on the agroclimatic and resource characteristics of the Three Rivers Plain region of eastern Heilongjiang, on project-related industry and infrastructure, and on the Heilongjiang General Bureau of State Farms organization. Supplementary information on system environment is found in appendices.

Next, economic theory and issues relevant to this research are discussed, including systems modeling, capital investment and project analysis, vertical integration, and the theory of transfer pricing within integrated firms. The theoretical review provides a background to the following two chapters, which contain a description of the methodology employed, an explanation of the investment-analysis model developed, and an outline of the model's underlying management and technology assumptions.

The investment-analysis model developed is a cash-flow accounting model that incorporates improvements in technological efficiencies over project life. Its primary purpose is to calculate internal rate of return (IRR) on investment based on pro forma net cash flows over a 15-year project lifetime. It would be adaptable to any large livestock or food processing project involving technology transfer. The model is subdivided into seven components. Intersystem transfer prices are employed as a mechanism to permit the study of individual components of the system as separate financial units. A simple criterion for setting equitable intersystem transfer prices based on model output was developed and applied to the system under study.

Results of the Base Scenario of the investment analysis model, as reported in Chapter VI, indicate an IRR of 22% for the joint venture before taxes. However, the enterprise does not generate a positive cash-flow until its sixth year, and represents a long-term investment, by any definition. Final model design was tested through a series of sensitivity analyses, relating system financial performance to changes in Base Scenario assumptions about technological efficiencies and exogenous financial parameters. In general, the model was more sensitive to financial than to technological assumptions. Following sensitivity analysis, several experiments were conducted to test the effect of changes in project design. For example, it was determined that the expansion of the project from the original design would probably be feasible, and that an extension of the duration of the joint venture agreement would probably improve IRR. Results presented in Chapter VI are tempered by a discussion of principal limitations of this research.

The final Chapter of this thesis includes an interpretation of some of the results of the study, and considers its implications with respect to technology transfer, changes in financial parameters, and the applications of the model's transfer-pricing technique. The general conclusion of the study is that there is potential for Sino-Canadian joint ventures in beef-production.

II. The Heilongjiang State Farm System and Alberta: Environmental Factors Affecting the Feasibility of Joint Ventures in Beef Production

As discussed in the next chapter, this study considers a hypothetical joint venture in beef-production in Heilongjiang as a particular system and attempts to estimate the likelihood of success of such a system. System "environment" includes all outside factors interacting with a defined system. The purpose of the current chapter is to discuss the environment of the system under study and determine how it is likely to affect the feasibility of a joint venture in beef-production.

The chapter begins with a summary of the similarities and differences between the two provinces and an outline of the sister province relationship which currently exists. It continues with a description of the Heilongjiang General Bureau of State Farms organization and the Heilongjiang Land Reclamation area, including a more detailed look at two particular state farms. This is followed by a description of the forage and beef productions systems currently in operation in Heilongjiang, and local slaughter and processing technology. The next section is a discussion of beef demand and supply factors in Heilongjiang and potential foreign currency markets for beef, and concludes with a general assessment of infrastructural capabilities relevant to integrated beef-production. Finally, there is a discussion of foreign involvement in Heilongjiang's agriculture industry, followed by sections on cultural and political factors likely to affect a joint venture in beef-production.

Statistical information relevant to the topics discussed in this chapter can be found in Appendix A, and the model and management descriptions of Chapter V are based in part on information found in this Chapter. The reader is also referred to Appendix B, which discusses the legal environment pertaining to foreign investment in the People's Republic of China (PRC).

A. HEILONGJIANG - ALBERTA: AN OVERVIEW

Alberta and Heilongjiang province, PRC, share a number of similarities, particularly with regards to climate and resource base. These similarities have been recognized by the governments of the two provinces and have resulted in an official twinning agreement or "Protocol of Friendship and Understanding" signed September 5, 1981. Many cultural, educational, and economic ties have developed between the two provinces since that time. Alberta's exports to the PRC increased by 8.7% from 1982 to 1985, a period during which the exports of Canada as a whole to the PRC increased by only 0.8% (Statistics Canada,1986).

Agroclimatically, Heilongjiang encompasses vegetation and soil zones very similar to those in Alberta, although the southern portion of Heilongjiang has a somewhat longer and wetter growing season than does Alberta, permitting large-scale cultivation of corn and soybeans. The natural vegetation of the province is diverse, ranging from northern spruce forests to dry alkiline grasslands in western Heilongjiang, to poorly drained lowland grasslands interspersed with oak and pine forests in eastern Heilongjiang. But despite many agroclimatic similarities, including the presence in both provinces of large rangeland areas unsuited or only marginally suited to crop production, the agricultural systems of the two provinces are fundamentally different. Heilongjiang's agriculture, and particularly the agriculture of the Heilongjiang Reclamation Area (HRA) is heavily dominated by grains and oilseed production. Livestock *including* processed meat products accounted for approximately 7% of state farm agricultural output in Heilongjiang in 1985 (GBSFH,1986), while in Alberta in the same year livestock sales alone accounted for 46.9% percent of total farm receipts (Alberta Agriculture,1986). Furthermore, in Heilongjiang, beef cattle are responsible for only a small portion of livestock output, whereas in Alberta beef represents the largest single source of farm income, and accounted for 29.8% of total farm receipts in 1985 (Alberta Agriculture,1986).

Beef is a rationed commodity in China, and yearly per capita consumption was only .28 kg in 1980 (World Bank,1985) (Per capita beef consumption in Heilongjiang is probably higher than for China as a whole.) The central government of China has ambitious targets for increasing beef-production and consumption in China (A 14.2 % per annum increase in beef production is targeted by central authorities to the year 2000 (World Bank,1985).). Heilongjiang is a province with resources to contribute to that goal.

The preceeding observations suggest that the potential exists for the application of Alberta technology in forage and beef production to the development of a beef industry in Heilongjiang.

B. THE HEILONGJIANG GENERAL BUREAU AND THE HEILONGJIANG RECLAMATION AREA

Unlike other parts of China, where farming is done by individual peasants on small plots, large portions of Heilongjiang Province are under the administration of the Heilongjiang General Bureau of State Farms (HGB). Many of these lands have only been cultivated since the liberation of Heilongjiang from Japanese occupation in 1949. Large state farms were developed by People's Liberation Army units retired from active duty during the 1950s. In comparison to the small intensively-farmed plots of southern China, Heilongjiang state farms are large and mechanized. Family farmers now rent a portion of the land within each state farm, following the reforms of 1984. The large region encompassing these state farms is known as the Heilongjiang Reclamation Area (HRA) and stretches from 123°40' (E) to 134°40' (E), and 44°10'(N) to 50°20'(N) (Li,1987), as delineated on Figure II.1.

This thesis addresses the potential for joint ventures in beef production between the HGB and Canadian interests; it does not address the potential for joint ventures with other organizations in Heilongjiang. Furthermore, the study concentrates on a region known as the Three Rivers Plain (See Figure II.1.), a productive delta region of eastern Heilongjiang. However, with minor modifications and different coefficient values, the financial model employed in this analysis could be applied to almost any beef-forage system in China or elsewhere.

The HGB is a large, multitiered governmental organization, responsible for administering much of the lands in the HRA. It is under the control of the Central Bureau of

Figure II.1: The Heilongjiang Reclamation Area and the Three Rivers Plain.

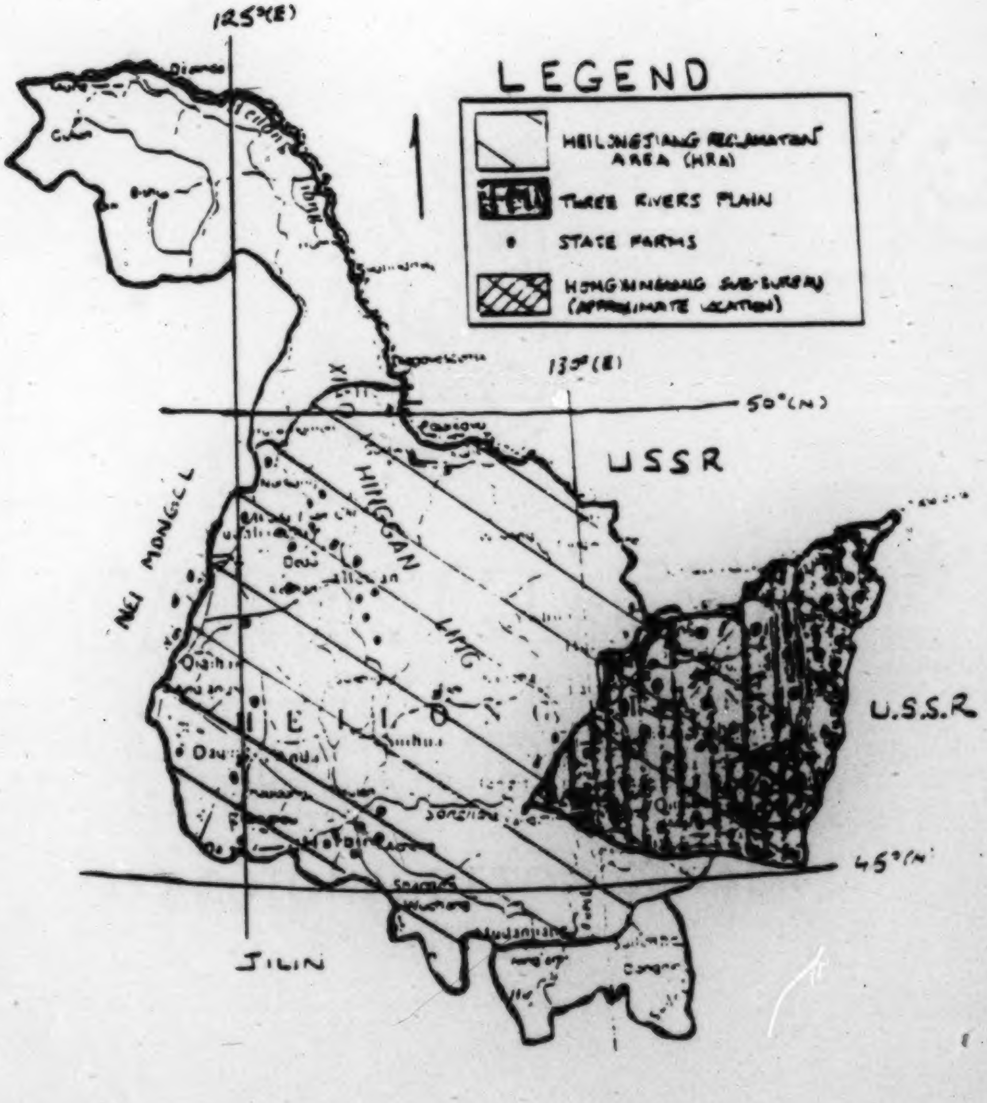
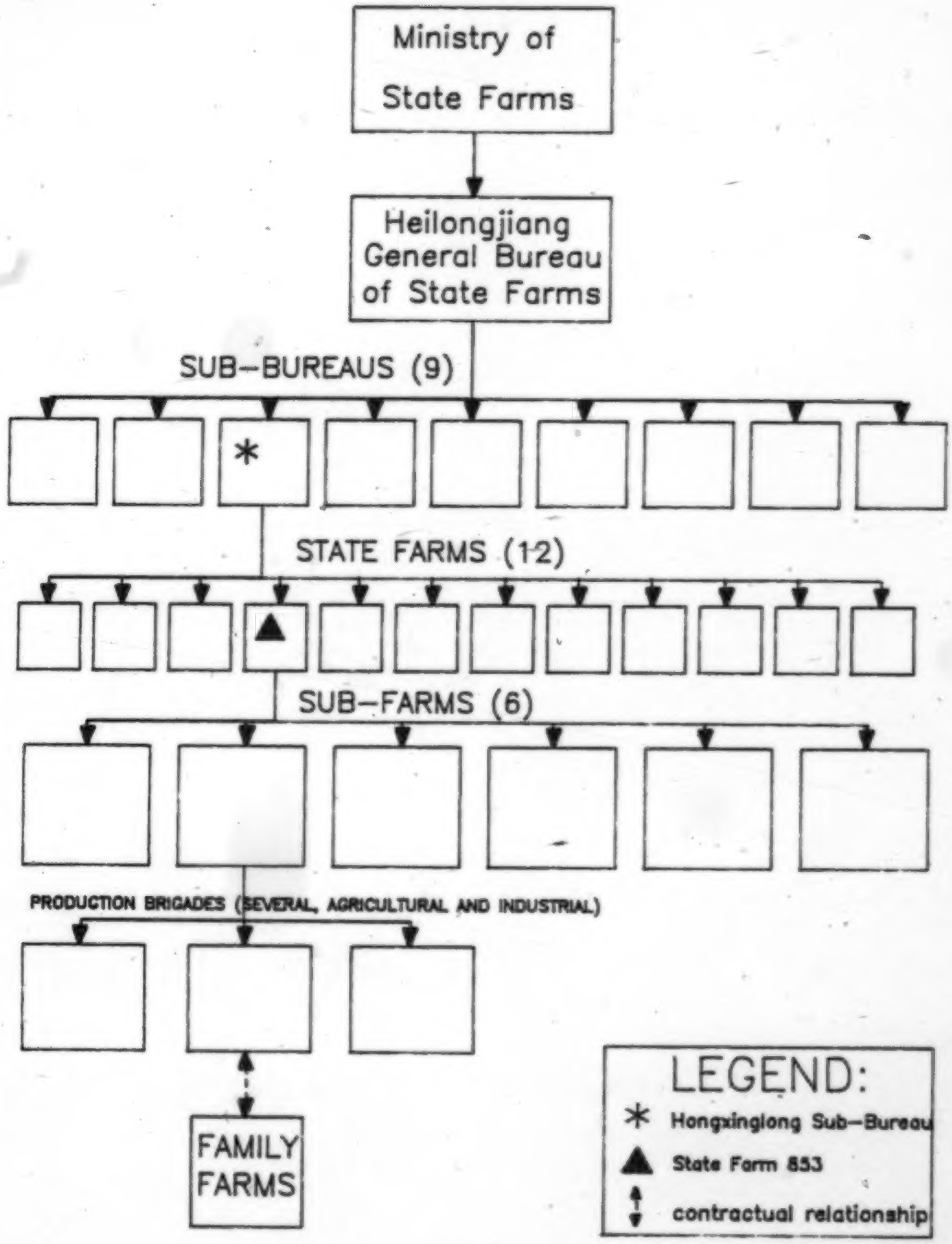

125°(E)
LEGEND
HEILONGJIANG RECLAMATION AREA (HRA)
THREE RIVERS PLAIN
STATE FARMS
HONGXINGLONG SUB-BUREAU (APPROXIMATE LOCATION)
135°(E)
50°(N)
USSR
NEI MONGOL
HINGGAN LING
U.S.S.R
45°(N)
Harbin
Mudanjiang
JILIN

Figure II.2: Organization of the Heilongjiang General Bureau of State Farms.


Ministry of State Farms
Heilongjiang General Bureau of State Farms
SUB–BUREAUS (9)
*
STATE FARMS (12)
▲
SUB–FARMS (6)
PRODUCTION BRIGADES (SEVERAL, AGRICULTURAL AND INDUSTRIAL)
FAMILY FARMS
LEGEND:
* Hongxinglong Sub–Bureau
▲ State Farm 853
↕ contractual relationship

State Farms in Beijing, but appears to operate with a considerable amount of autonomy. The headquarters of the HGB is in Jiamusi, near the largest concentration of state farms in China. The HGB is subdivided into nine regional sub-bureaus as can be seen in Figure II.2. Each sub-bureau contains from nine to twelve state farms, in a particular region. Larger farms are subdivided into several sub-farms, and all state farms are separated into production brigades. It is important to recognize the broad scope of activities performed by organizations under HGB control. These range from agricultural product export to lumbering, from machinery manufacture to film and video production, and include grade schools, universities, and scientific research facilities (See Appendix A for a listing of organizations under HGB control plus a listing of all SFs in Heilongjiang.). In addition to having a broad scope, the HGB is a large organization, with a total output of Y[3]2.4 billion in 1985, Y1.4 billion output of agricultural products, and a combined workforce of 708,036 (GBSFH,1986). Table II.1 notes some summary statistics on the HGB; more detailed information can be found in Appendix A.

State Farms 852 and 853

Two farms were singled out by authorities as being best suited to a study and project of this type, State Farms 852 and 853. These farms are located in the Hongxinglong sub-bureau, approximately 225 km southeast of Jiamusi (See Figure II.1.). Table II.2 is brief summary of the resources and organizational structure of these two farms. The farms are large, locally-administered organizations responsible for all social services and commercial affairs for regions comparable in size to an Alberta municipality. Similar to the HGB as a whole, the farms operate a wide range of enterprises, in addition to their primary enterprise of grain and oilseed production. In 1985 on State Farm 852, crop production accounted for 60% of total farm output, while industrial production amounted to 37% and livestock only 2.5%. There is a strong interest in developing food processing and light industry on Heilongjiang state farms, to increase farm income and provide employment. Examples of non-farm enterprises on 852 and 853 include soybean processing plants, breweries and

---

[3] "Y" denotes Chinese Yuan, officially exchanging at 0.36/$CDN in June,1987.

Table II.1: Heilongjiang General Bureau of State Farms: Summary Statistics.

Statistic	Value
General Statistics	
number of state farms	101
animal husbandry state farms	4
area, smallest state farm	6667 ha
area, largest state farm	1,066,670 ha
production brigades	2599
animal husbandry brigades	64
farming brigades	1944
forestry brigades	120
sideline brigades	48
fishery brigades	30
family farms	160,000
industrial enterprises	728
building construction companies	188
business enterprises	320
shops, stores, and stations in business network	5690
enterprises run cooperatively by state farms and local governments	87
Academic Facilities	
scientific research organizations (General Bureau level)	9
as above, state farm level	62
total teaching institutions, all levels	2282
institutes of higher education	4
technical schools	18

Source: General Bureau of State Farms in Heilongjiang. Statistics Yearbook, 1985. Jiamusi, GBSFH, 1986.

wineries, sawmills, fish farms, and light machinery manufacturing plants.

The hierarchal system of command employed on state farms is effective for the implementation of decisions made by the higher level managers, and may be attributable to the military origins of most Heilongjiang state farms.

C. FORAGE AND BEEF PRODUCTION SYSTEMS ON HEILONGJIANG STATE FARMS

This section examines the agroclimatic and resource characteristics of the Three Rivers Plain relevant to beef-production and looks at the current state of forage and beef-production, and of processing technology in the province.

Table II.2: State Farms 852 and 853 - Resource Summary.

Item	Units	852	853
total area	km^2	1363	1200
cultivated area	ha	72,680	53,300
native grassland	"	9680	26,000
forest	"	13,500	n.a.
population		59,076	40,983
workforce		27,267	20,090
total farm income	Y	90,134,000	n.a.
value of crop production	"	4,430,000	n.a.
value of livestock production	"	2,263,000	n.a.
value of industrial production	"	33,440,000	n.a.
dairy cattle	head	1000	500
beef/draft cattle	"	1000	1000

Source: Interviews and farm records.
Note: Cattle inventories are approximate, since over 90% of dairy and 100% of beef/draft cattle are privately owned by family farms.

The Three Rivers Plain

The Three Rivers or Sanjiang Plain is a large, low-lying region of eastern Heilongjiang, encompassing the deltas of the Amur (Heilong), Songhua, and Ussuri (Wusili) Rivers. Its elevation ranges from 40 to 90 meters, although the Wanda mountains and several other ranges of hills interrupt the otherwise level topography. It includes over two million hectares of arable land and is considered to be the "granary" of Heilongjiang. As can be seen from Figure II.1, the majority of state farms are located within the boundaries of this plain.

Climate

The climate of the Sanjiang Plain is classified as frigid-temperate-continental-monsoon[3]. It is roughly comparable to the climate of the Red River Valley of southern Manitoba, with hot humid summers and cold dry winters. Only 5 to 7% of annual precipitation falls from November 1 to March 1, and January mean temperature is -18 to -20°C, with temperatures as low as -40°C in the far northeastern corner of the plain. There is little snow cover, and soil freezes to an average depth of 2.2 meters, thus forage varieties must be very winter hardy.

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[3] Information on Heilongjiang climate from Professor Zai Yu-zhong, Department of Basic Sciences, Heilongjiang August First Land Reclamation University (HALRU).

Spring is a season of rapid warming and high winds on the Three Rivers Plain. Fifteen to nineteen % of annual precipitation normally falls in spring, and insufficient moisture at this time of year is sometimes limiting to crop production, especially when combined with frequent high winds. From March 1 to May 1, average temperature increases 17 to 19°C, and winds of degree 5 (28.8km/hr) and higher are common. Sometime in May, average temperature reaches and stays above 10°C.

Summer provides ideal growing conditions. Sixty percent of annual precipitation falls during June, July, and August; July average temperature is 21 to 22°C, with an absolute maximum of 37°C.

Temperatures cool rapidly in the autumn, during which 18 to 22% of annual precipitation falls. Total autumn rainfall exhibits greater year to year variation than spring and summer rainfall.

Total annual precipitation on the Three Rivers Plain is greater than in most parts of Alberta, averaging 550 to 600mm in the eastern portion of the plain, and 500 to 550mm in the western part (On State Farm 852, average precipitation is 600mm. Record high was 806mm in 1981; record low was 346mm in 1975. Source: Farm Records.). There are 1250 to 1450 hours of sunlight during the Three Rivers Plain growing season, which exceeds the growing season sunlight of the Yellow River region of southern China. The growing season usually runs from May 10 to September 28, ranging from 131 to 145 days (based on a criteria of average daily temperature >=10°C.). There is an average of about 125 frost free days, which can range from 90 to 150 depending on the farm and the year. For perennial crops and native species, the potential growing season (based on a criteria of average temperature >=0°C.) runs from about April 5 to October 25, or 202 to 209 days.

Key climatic constraints to production for field crops on the Sanjiang Plain are waterlogging and mild drought. For perennial forages, the principal environmental constraints are winterkill and spring dessication (Agdevco,1985(1)).

Resource Suitability

A number of underdeveloped and undeveloped resources of the Sanjiang Plain could be used for large-scale beef-production. The most important of these are large tracts of lowland grasses of a *Calamagrostis angustifolia* range type. Most of the cropland on the Sanjiang Plain was originally native grassland. However, there is little further reclamation of these lands scheduled beyond 1987, the final year of a World Bank drainage and land reclamation project on the Sanjiang Plain. The large investment necessary in drainage and road building to develop the remaining lowland grasslands is not justified by current crop returns, particularly without further outside farm investment (Zhang Zhi-yi,pers.com.1986). Large tracts of land (>300,000 hectares by HGB estimates) remain essentially unused at present, primarily because of poor drainage. Table II.3 is a breakdown of grassland resources for State Farm 853, which contains over 20,000 hectares of useable (suitable for cattle use, as defined by the farm's survey) grassland, less than 5% of which is currently grazed or harvested. The marsh reedgrass rangetype is relatively nutritious (approximately 10% crude protein in July, according to one State Farm 852 test), but definitive information as to its palatability and overall suitability for grazing is unavailable at present. Similar species in Canada provide poor grazing or early season grazing only, due to high fibre content of stems (Campbell,1956). However, much of the grassland area is level, and suitable with minor improvements for native hay production or seeding to more productive and palatable tame species. On most lowland sites, a certain amount of surface drainage investment would be necessary to ensure grazing could take place during periods of peak rainfall. The trampling effect of intensive grazing may also help limit the potential for waterlogging.

Approximately 27% of the cultivated area of State Farm 852 and many other state farms on the Sanjiang Plain is an upland landform with a problem soil known as Upland White Clay (Agdevco,1985(1)). This soil has a light colored hardpan at 20 to 30 cm which is limiting to crop production. One proposed remedy to the hardpan problem is the introduction of perennial forages, particularly alfalfa, into the cropping rotation.

Table II.3: State Farm 853: Summary of Rangeland Resources.

Resource	Area(mu)*	Area(ha)
Total Rangeland Area	390,000	26,000
Type I. wet lowland		
Total	220,098	14,673
Useable**	182,372	12,158
Type II. dryer lowland		
Total	171,690	11,446
Useable	145,059	9670
Total Useable Rangeland	327,431	21,828
Above area not currently in use	313,740	20,916

*One mu = 1/15 hectare
**"Useable" defined as suitable for cattle grazing, according to SF surveyors.
Source: Map of Range Resources, SF 853.

Currently on State Farm 852 there is a CIDA-financed project underway which is attempting to find suitable forage varieties for this soil and assess their effectiveness for improving soil quality. The project also includes a dairy herd development program to utilize the forage produced. There is an interest in introducing forage crops as a regular component of the the cropping rotation, should results from the CIDA project prove favorable.

Another forage resource available for beef production is crop wastes and byproducts from other state farm operations. These include items such as wheat straw, sugar beet tops and pulp, soy meal, and crop residues.

Forages, Beef Production, and Processing in Heilongjiang - Current Technology

Forages

Background information on forage production in Heilongjiang, and particularly the Sanjiang Plain, is limited. This is understandable, since grain still dominates production and only in the last several years has there been an interest in forage production, primarily for the development of the dairy industry. Local varieties of alfalfa and a number of tame grasses exist, but seed is in extremely short supply. Furthermore, effective forage seeders are not manufactured in China, and most silage harvesting equipment is imported from Germany. It can be assumed that, for any large scale beef-production project, seed, equipment, and technology relevant to forage-production will have to be imported. The State Farm 852 CIDA project should provide a large amount of information on the practicalities of forage establishment and production on the Sanjiang Plain.

Beef

With the exception of artificial insemination (AI) technology, cattle production is also underdeveloped by western standards. The Heilongjiang "August First" Land Reclamation University (HALRU) Animal Husbandry Department has several professors familiar with dairy production, nutrition, and genetics, but no experts in the field of beef production. There are only approximately 54,000 beef/draft cattle on Heilongjiang state farms[4], about 1000 beef/draft cattle, and an equal number of dairy cattle each, on State Farms 852 and 853. Thus the number of cattle, both beef and dairy, is overwhelmed by the scale of resources available for cattle-production. Most of these cattle are multipurpose (draft and beef) animals of the domestic (Yellow Cattle) breed or F1 domestic X European crosses. Because the animals are used extensively for draft purposes, and fed primarily on crop residue from the fields, with little or no nutritional supplementation, productivity is very low (See Table II.4.). Table II.4 also shows the superiority of crossbred and dairy type cattle over native Yellow Cattle for beef-production. The stress in recent years on dairy herd development has had a significant impact on the Heilongjiang beef industry. Firstly, it is now common practice for farmers to purchase dairy bull calves from dairy farmers or state farm herds, for the purpose of feeding to slaughter weight. The state farm dairy herds, currently still increasing in size, should ultimately provide a source of productive female cattle which could form the basis of a beef synthetic herd[5].

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[4] See Appendix A. This in comparison to 1,220,000 beef cows on farms in Alberta as of July 1, 1985. (Alberta Agriculture,1986).

The introduction of European and, to a lesser extent, North American genetics into Heilongjiang dairy and beef herds has taken place almost entirely through the use of artificial insemination (AI). Bulls are rarely seen in the Heilongjiang countryside and AI technology is widely practiced. Located in Harbin is the Animal Breeding Center of Heilongjiang, a facility which trains AI technicians and distributes dairy and beef semen throughout the province to meet an increasing demand. Its facilities are modern and it has also been the beneficiary of a CIDA development project. Each year 100 to 150 technicians trained in AI graduate from the Animal Breeding Center of Heilongjiang and obtain employment at the county or SF level as AI instructors (Sun Ching-shang,pers.com.1986). The plentiful supplies of inexpensive skilled labor, and high quality facilities for storage and transport of semen, suggest that AI can ultimately play an important role in the development of Heilongjiang's beef industry.

Slaughter and Processing

Volumes of beef slaughter in Heilongjiang are very low, and slaughter as percentage of cattle inventory for the Heilongjiang state farm system is under 10% (GBSFH,1986). Most beef produced on state farms is slaughtered and marketed in local free-markets by family farmers. The largest beef slaughtering facility in the province is the Harbin Beef and Mutton Processing Plant, with a highly variable daily slaughter of 35-200 cattle, in addition to a larger number of sheep[6]. Technology is old and, to a large extent, locally improvised. The plant receives a state subsidy, since continued production is deemed necessary to supply the ethnic (Muslim) market for beef and mutton. Animals are transported to the plant by truck and rail, and graded and priced on-site on a liveweight basis. Slaughter is done by Muslim priests using a sabre, and the meat reserved for Muslims with ration coupons or for Muslim

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[5] The University of Alberta Department of Animal Science has developed a very productive beef synthetic based largely on dairy breed genetics (Berg et al,1986).

[6] Information based on visit to facility in November, 1986.

Table II.4: Heilongjiang: Some Estimates of Cattle Productivities Under Current Management Practices.

Type of Animal	ADG (kg)		Liveweight (kg)		
	0-6mo.	6-18mo	6mo	15-16mo	18-20mo
"black and white"*	.7-1.0**	.6	170	350	400
yellow cattle	.5	<.5	n.a.	n.a.	300-350
F1 yellow X European	n.a.	n.a.	n.a.	n.a.	350-400

*Chinese "black and white" dairy breed contains holstein and yellow cattle genetics.
**Range in values reflects relative management intensities.
Sources: Dept. of Animal Husbandry, HALRU, and Sun Ching-shang, Animal Breeding Center of Heilongjiang, November, 1986.

restaurants. Meat is either sold fresh the same day or frozen as sides for shipment to other cities or for storage until needed. Edible byproducts are cooked on and sold from trucks owned by the plant. The majority of plant employees are involved in processing of byproducts.

Equipment for large scale freezer storage is readily available in China and in use in several facilities in Heilongjiang. The freezer installations consist of large diesel-powered electric generators which operate liquid ammonia parallel-pipe cooling-systems, and appear to provide effective and inexpensive long-term storage of frozen products. According to the manager of the Harbin Refrigeration Plant, storage operating costs at -18°C are 0.30 Y/tonne/day (November,1986).

Basic meat processing equipment is also manufactured in China, and utilized in Heilongjiang plants to produce smoked and canned meats for domestic and export markets. Meat processing areas tend to exhibit higher hygiene standards than slaughter areas, and typically have white tile walls and stainless steel tables. Processing equipment in some plants appears to be underutilized. Nonetheless, labor is a relatively minor component of food processing costs in Heilongjiang (Xu Bu-ke,pers.com.1986).

There are large deficencies in Heilongjiang technology for beef slaughter and processing in comparison to world standards, particularly with regards to packaging technology and sanitation levels. However, certain technologies currently in use would have application in a more modern beef slaughter and processing system. Furthermore, export standards can be and are met in Heilongjiang meat-processing facilities.

D. MARKETS AND INFRASTRUCTURE

The following section is a brief overview of marketing and infrastructure environment in which a joint venture in beef-production in Heilongjiang would operate.

Beef and Byproduct Markets in Heilongjiang

The marketing and pricing of fresh meat, including beef, is under government control in Heilongjiang[7]. Even so-called "free-market" vendors sell their wares under government supervision. Typically, fresh meat sells according to a dual price system, the first price being the official state price, and the second being the free-market price. For beef, the state price is always the lower of the two, and supplies are normally reserved for Muslims, who are granted special ration coupons. Meat rationed and sold at state price is slaughtered at subsidized state slaughter plants and sold in government retail outlets.

A large quantity of meat is sold outside the official state system by private vendors, usually by the farmers who produced and slaughtered those animals. Vendors pay a small fee for the use of a market stall and must comply with the regulations of the free-market administration, or forgo the privilege of selling there. These regulations consist of rudimentary health standards, periodic scale inspections, and price limits. Thus, while the official state price for beef as of November, 1986 was 3.4Y/kg, the highest price observed on the free-market was 4.0Y/kg. One market manager stated that a price of 4.0Y/kg triggers various forms of control, and only occurred when there was only a single beef vendor. It was observed that neighboring vendors sell their products for identical prices.

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[7] Information contained in this section is based primarly on personal observation and on interviews with market managers.

There is little or no price discrimination among various cuts of beef at both state stores and the freemarket. Concomitantly, there appears to be little knowledge as to the relative attributes of various cuts of beef; certainly there is no standard similar to that employed in Canada. For pork, there is a very slight (<10%) price discrimination between cuts. However, for both beef and pork, offal appears to be in higher demand than meat, and commands a price premium. Tripe, heart, and other byproducts are considered to be delicacies and are often very difficult for the consumer to obtain. Canned beef tripe produced by the Jiamusi Food Processing Plant of the HGB retailed for approximately 8Y/kg in November 1986.(Xu Bu-ke,pers.com.1986). Cooked beef liver sold in free market stalls in Harbin at a price of 4.8Y/kg at a time when non-rationed beef was selling for 3.9Y/kg.

Table II.5 summarizes some price information collected from various markets in Heilongjiang in 1986. Important ways in which the Heilongjiang beef marketing system differs from Alberta's can be summarized as follows:

4. Product quality, packaging, and hygeine standards are much lower in Heilongjiang.
5. Heilongjiang beef retail prices are considerably less than half of Alberta prices.
6. There is very little price discrimination in Heilongjiang.
7. Edible byproducts are more expensive than meat in Heilongjiang, and are in high demand.

In addition to the strong market for edible byproducts in China, there appears to be a good market potential for inedible beef byproducts, particularly hides. A number of tanneries and shoe factories operate in Heilongjiang, such that the province must import in excess of 100,000 raw cattle hides annually from other parts of China and overseas (according to information provided by Harbin Hat and Shoe Trading Co. November, 1986.). This represents both a drain on foreign currency reserves and a constraint to expansion of the relatively profitable leather industries (according to officials at the Harbin Shoe Factory, November, 1986.). At the state farm level, ample demand exists for protein supplements by farmers raising poultry. Thus, there would likely be little problem marketing blood meal and bone meal locally.

Table II.5: Heilongjiang Meat Prices in Yuan per kilogram, Mishan and Harbin, November, 1986.

Location and time	Rationed Pork	Rationed Beef	Non-rationed Beef	Ground Beef	Cooked Beef Liver
Mishan, Nov.7	3.2	3.4	4.0	n.a.	n.a.
Harbin, Nov.25	3.3	3.3	3.5-3.9	4.0	4.8

Source: Author's market survey.

Foreign Currency Beef Markets

A detailed survey of potential foreign currency markets for Heilongjiang beef was not performed for this study, since the primary mandate of the work was to research the economics of production of beef on state farms in Heilongjiang. Markets proposed by Chinese authorities and foreign businessman who have considered this topic include:

1. embassies, foreign exchange grocery stores, and foreigner hotels in Beijing and other major cities in China.
2. U.S.S.R.
3. Hong Kong.
4. other Asian markets.

Probably one of the major contributions of a foreign partner in beef-production would be to facilitate the export of the higher value products of the enterprise. The modest scale of production of the possible joint venture under study would likely constitute an advantage with regards to finding market niches for the products of the joint venture within China, but a disadvantage when pursuing export markets.

Infrastructure

Poor quality of or lack of supporting infrastructure is likely to be one of the problems faced by a joint venture in beef production located in rural Heilongjiang. Potential bottlenecks include poor and erratic power supply, congested and rutted roads, and poor or nonexistent telephone connections. International communication may be particularly problematic. Some of these problems can be accomodated by adaptations of project design, including back-up power generators and use of Chinese-made, diesel-powered refrigeration equipment instead of North American, electrically powered equipment.

However, much of the infrastructure of the Sanjiang Plain is improving. This is particularly true of the road system, which is improving rapidly under recent and ongoing road building programs. Truck transport of refrigerated and frozen products from farms on the Three Rivers Plain to the cities of Harbin and Jiamusi already takes place on a regular basis. Rail lines provide dependable service to most of the region, including the Hongxinglong sub-bureau. General Bureau transit offices and storage facilities, located in all major cities and ports of northern China, are able to facilitate the transit of inputs and products between the Heilongjiang Reclamation Area and the outside world. The export of frozen poultry from five state farms on the Sanjiang Plain to Hong Kong is one example of the capabilities of the HGB infrastructure that is particularly relevant to this study[1]. Export has taken place on a regular basis during spring, summer, and fall over the past four years and has involved transport by a combination of truck, rail, and ship. There has been no loss of product over the lifetime of the business venture.

E. FOREIGN INVOVLVEMENT IN HEILONGJIANG AGRICULTURE

The impact of China's open door policy on the agriculture industry of Heilongjiang is readily apparent (See Appendix A.). Foreign involvement in Heilongjiang agriculture falls into four catagories:

1. financial involvement.
2. direct trade, including cash purchase or barter of western technology.
3. joint ventures.
4. aid.

There are no statistics available as to the relative importance of these four catagories. However, the magnitude of a World Bank land reclamation project, currently in its final year of operation, suggests that financial involvement has been a very important component of foreign contribution to Heilongjiang's agriculture industry. After financial involvement, direct trade and commercial involvement appear to be very prominent, particularly between the HGB and Japanese, German, and American firms. Examples include sale of German soybean processing equipment to large processing plants under construction, special arrangements between farm machinery companies and state farms, and countertrade/loan arrangements with state farms and Japanese equipment exporters.

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[1] Information provided by Chuang Ye, State Farm 859 Chicken Plant, June,1987.

The HGB is party to a joint venture with a Japanese brewery for the purpose of testing and breeding malt barley. The HGB also supplies breeding stock to a Sino-Australian pork production joint venture in southern China, and reportedly has several other joint ventures under negotioation (Sun Ching-shang,pers.com.1986).

Direct aid appears to be one of the smallest components of foreign involvement in Heilongjiang. The Danish government has supported the export of a large milk powder plant to Heilongjiang, and the Canadian government has implemented several large CIDA development projects as well as the financing of smaller feasibility studies/pilot projects, including projects pertaining to the beef industry. There has also been aid provided to Heilongjiang agriculture by the government of Alberta, including a range improvement and development project, ongoing in western Heilongjiang since 1983 (Bjorge,1983).

The synopsis of the preceeding observations is that organizations in Heilongjiang's agriculture industry, and particularly within the HGB, are interested in, and actively pursuing, a wide variety of relationships with foreign interests. It appears that financial and commercial ties have been and will continue to be more important than aid in terms of total dollar involvement. Canadian involvement to date has been primarily aid related.

F. CULTURAL FACTORS

The role of cultural factors on project feasibility is critical, and can be summarized in the following question:

Will the large scale breeding and production of beef be feasible within a culture which has no tradition of beef production and where cattle have traditionally been regarded as beasts of burden?

This question has been posed in several forms by Canadian cattle experts with experience in the Chinese livestock industry. The concern is valid, and fundamental to the feasibility of a joint venture in beef-production. The impact of varying degrees of success in transferring Alberta beef breeding technology and, more importantly, management philosophy, on the project's financial performance can be tested by adjusting technological coefficients for beef-production (Components 3 and 4) and noting their impact on key financial output (See Chapter VI.). Exactly what level of performance is attainable, however, cannot be determined in any feasibility study and is purely speculative. Of all the technological parameters and relationships outlined in the investment analysis model of this study, those dealing with animal husbandry (Components 3 and 4) are probably the most uncertain, owing to an almost total lack of experience on the State Farms in beef-production.

The present dairy and "beef" industries of Heilongjiang are based on private ownership of very small herds by family farmers. Cattle are produced on scavenged pasture and forage resources, with little or no supplemental input. In addition to obtaining feed at no charge, cattle owners benefit from substantial state farm subsidies (Terry Lee,pers.com.1987). Low or no input costs favor the retention of animals until they are no longer capable of producing milk or supplying draft power. Consequently, the majority of beef sold in local markets is eight years of age or older.

The strategy of cattle production discussed in the previous paragraph is sharply in contrast to the high input, rapid turnaround, type of management proposed in this study, and would require large adjustments in animal husbandry practice and attitudes. Certainly, one of the largest challenges would be to introduce the concept of payment for use of pasture and forage resources.

A related issue is how successful a joint venture would be in finding a stable position within the cultural and organizational framework of its situation, particularly in light of the fact that state farm structure is still in a process of major readjustment, following recent reforms (Zhang,1986). For example, it is quite possible that better standards of animal husbandry would be achieved if maintenance of the breeding herd was performed by family farms ~~or group farms~~ under contract to the joint venture, with technical assistance and production advice provided by the joint venture.

G. POLITICAL FACTORS

The central and dominating political issue of this research is whether or not the Chinese political environment is favorable to a long term (15 year) investment by foreigners. The political climate of China has an important bearing on the feasibility decision of any Sino-foreign joint venture, and has been discussed in detail by other authors, including Brown (1986), Anderson (1986), Gordon and Chan (1986), and Ho and Huenemann (1984).

Political events since 1979 have not altered the basic intent nor reality of the open door policy, and legislation pertaining to foreign investment has become more favorable in that period (See Appendix B.). China has become more active internationally, including recent involvement with GATT and IMF. With particular reference to this research, China has become a signator to the *Paris Treaty on Protection of Industrial Property Rights* and a member of the *World Intellectual Property Organization* (Ma,1986). On the negative side, investors must consider the history of state policy to foreign firms for the entire period following the revolution, and the uncertainty which exists, as the government of China undergoes another transitional period.

Appendix B provides an overview of how the legal environment relative to foreign investment in China, and particularly joint venture investment, has evolved since 1979, and concludes that the potential for foreign involvement in China is becoming more favorable with time.

III. Theoretical Review

This study is broad in scope, covering several disciplines, embodying a number of economic concepts, and addressing several theoretical issues. In essence, however, the problem can be simplified to the application of certain financial analysis and modeling tools to a special production economics problem. The goal of this chapter is to provide an overview of pertinent economic theory and to introduce the most important theoretical issues addressed in the research. The discussion is subdivided into four sections: systems modeling, capital investment and project analysis, vertical integration, and transfer pricing.

A. SYSTEMS MODELING

According to Spedding (1975), "systems are sets of components that interact with each other in such a way that each set behaves as a whole entity"[9], or, according to Gardner (1987), systems are "any process that transforms inputs into outputs".[10] A number of principles appear to be emerging from the broad and diverse systems literature:

1. **Purpose.** Systems are a collection of activities involving resources and agents to achieve a purpose (Nadler,1967).
2. **Environment.** Systems have defined boundaries. All entities outside the system which interact with the system constitute that system's environment (Spedding,1979).
3. **Steady State.** A system completely closed to its environment will achieve a definable equilibrium. There are very few real-life examples of closed systems. All other systems (open systems) either deteriorate, grow, or maintain a steady state, in which there is stability but continuous interchange with the environment.
4. **Entropy.** Forces of entropy result in a tendency for open systems to become more closed (Lawlor,1987).
5. **Equifinality.** Different starting points and different paths can be used to achieve a

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[9] Spedding, C.R.W. 1975. **The Biology of Agricultural Systems.** Academic Press. San.Fr. p.14.

[10] Gardner, R.J. 1987. "Systems Theory in Mathematical Economics" Chap. 3 in Fox, K.A. and D.G. Miles (eds.) p.50.

comparable final steady state for two similar systems (for example the beef-production systems of Alberta and Heilongjiang.) (Lawlor,1987).

The complex interrelationships between subsystems, and between a given system and the outside environment, necessitates a unified "systems approach" to problem study in many fields (Dent and Blackie,1979).

Systems theory is applicable to this particular study. An integrated beef production enterprise could be considered holistically as a complex ecological and socioeconomic system designed to produce beef and beef byproducts (outputs) from land, labor, capital, and management (inputs).

Austin (1981) is an advocate of the "systems approach" in the analysis of agroindustrial projects such as an integrated beef-production enterprise, because of its emphasis on the financial and socioeconomic links between actions and actors of a system. The consideration of individual subsystems alone (the reductionist approach), is inadequate to address the central question of this research as previously defined. Rather, it is necessary to effectively integrate and modify the various components of the total beef-production system, defined through systems analysis. Many linkages and interrelationships among these components constitute the unique character of systems analysis and design.

Systems analysis is "the process by which an investigator with a specific objective initiates modeling or research."[11]Commonly, a model of the system being studied is constructed to duplicate the essence of the input to output process in a framework more manageable than the system itself.

There are many criteria for selection of the type of model chosen to represent a system, based on system characteristics, modeling objectives, and time and data constraints. For complex time dependent systems, the class of recursive non-mathematical computer models known as "simulation models" are advocated (Dent and Blackie,1979), whereas for well defined continuous processes, various mathematical models, including linear and quadratic programming models which employ optimization routines, may be employed.

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[11] Johnson, S.R. and G.C. Rausser. 1977. "Systems Analysis and Simulation" in Judge et al (eds.) p.168.

Finally, for systems which are not time dependent, or for which time is of secondary importance, a non-optimizing accounting type model may be employed to facilitate system analysis.

The model format chosen for this study best falls into the third catagory. Time is a factor in that annual biological cycles such as forage production and cattle breeding are inherent characteristics of the system and technological coefficients improve over time (See Chapter IV.). However, the small number of discrete time intervals (15), and the financial emphasis of the study, both favor a less time dependent approach. Consequently, a simpler investment analysis type of model is employed.

The model format chosen does not incorporate optimization. Optimizing models are best suited to problem solving within continuous well-defined systems (Johnson,1987), and are not particularly applicable to feasibility decisions for large new systems. The thrust of this research was to define, model, test, and experiment with possible rather than optimum joint venture beef-production systems. Most importantly, there is a scarcity of acceptable data with which to conduct optimization analysis, particularly with respect to comparison of cattle feeding and forage production strategies on Heilongjiang state farms. Finally, the use of technological improvement functions (TIFs) in this model (See Chapter IV.), defined as percentage per annum improvement in various technical coefficients, does not facilitate optimization calculation. The use of non-linear production functions rules out the use of conventional linear programming techniques.

The five steps of model construction in systems analysis as listed in Johnson and Rausser (1977) and other references are:

1. specification
2. paramater estimation
3. verification
4. validation
5. revision

Sensitivity analysis could be considered part of the verification process, and is the process of collecting information with which to evaluate the robustness of decisions taken in constructing and applying models (Maffei,1958). Generally, in sensitivity analysis, attention is drawn to areas of greatest doubt and ignorance, which, for this particular study, includes technological coefficents and output prices. According to Johnson and Rausser (1977), "a model which is very sensitive to changes in assumptions about which there is substantial uncertainty will warrant skepticism."[12] The goal of the entire model construction process should be to produce a model which is appropriate and valid for experimentation with the system under question.

B. CAPITAL INVESTMENT AND PROJECT ANALYSIS

Capital Investment Analysis

A central component of project analysis and of this research is capital investment analysis. For large projects, particularly agricultural and agroindustrial projects, internal rate of return (IRR) is the preferred method of capital investment analysis (Gittinger,1982). By definition, the IRR is the rate of discount which will equate present value of net benefits with the cost of the project. Put another way "it (IRR) represents the highest rate of interest an investor could afford to pay, without losing money, if all the funds to finance the investment were borrowed, and the loan (principal and accrued interest) was repaid by application of the cash proceeds from the investment as they were earned."[13] Other names for IRR are marginal efficiency of capital, rate of return over cost, and discounted rate of return (Quirin, 1967).

IRR can be calculated by iteratively solving the following equation for r:[14]

$$\Sigma Q_t (1+r)^{-t} = \Sigma C_t (1+r)^{-t}$$

Where: Q_t = investment benefits in time period t

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[12] Johnson and Rausser, op.cit. p 193.

[13] Bierman, H. and S. Schmidt. 1980. **The Capital Budgeting Decision.** Macmillan, Toronto. p.31.

[14] Quirin, G.D. **The Capital Expenditure Decision**. R.D. Irwin, Homewood, Ill. p.41.

C_t = investment costs in time period t

r = IRR

Intuitively, it can be seen that there is a relationship between the concepts of IRR and benefit/cost ratio, and that every project with a B/C ratio >1 will also have a positive IRR.

For analysis of mutually exclusive investment alternatives, or for cases where cash flow may change signs more than once during the life of the project (for example, a project with large cleanup or disassembly costs in the final year of operation), IRR as a method of analysis presents special problems and should not be used (Lumby,1981). However, neither scenario is likely in the economic and financial analysis of agricultural projects (Gittinger,1982). Possibly the greatest advantage of IRR over net present value (NPV) analysis is that it is easier to visualize the concept of yield on investment (IRR) than the concept of net present value (Casler, et al.,1984).

Project Analysis

The investment decision for a large agricultural or agroindustrial project is far more complex than the investment decision for a single capital asset. Thus a literature has developed which examines the special considerations of project analysis, particularly in third world applications. This literature contains many elements which are applicable to this study, and is especially useful for the attention which is paid to problems peculiar to projects in lesser developed countries (LDCs). However, most of the research is directed towards projects organized and financed by one or more of the international-aid lending institutions, and thus is not entirely applicable to a privately financed, commercially-oriented, beef-production enterprise.

Ripman (1964) developed the first published catagorization of project analysis, dividing project analysis into the following six aspects: technical, institutional-organizational-managerial, social, commercial, financial, and economic. These aspects of project analysis have been elaborated on by Gittinger (1982).

The focus of this thesis is on the financial aspects of the hypothetical project, since without suitable financial incentive a joint venture in beef production would not take place. A potential pitfall of emphasis on IRR in project analysis is noted by Apedaile:[15]

> By focusing on what is necessary to achieve a norm based rate of return, rather than what may be possible, analysts are easily drawn away from sensitive designs to assumptions which cannot be fulfilled about rates of improvements in technical coefficients, staffing, training, procurement and disbursements, not to mention popular participation.

It is intended that base scenario technical coefficients for the financial model employed in this study be relatively conservative and that non-financial aspects also be addressed in order to ensure that the methodology employed gives relatively unbiased and realistic answers to the main research question.

Continuing with Ripman's six aspects of project analysis, technical analysis is an important component of this study, concerning the projected inputs (supplies) and outputs (production) of real goods and services by the project. For this particular study, the technical analysis component has been the most time consuming aspect, involving the collection of information on pasture and forage production, beef breeding and feeding, slaughter, and processing, for both Canada and China. Some of the technical analysis information is summarized in Chapter 2 and Appendix A of this thesis, and more is embodied in the computer model described in Chapters 4 and 5.

Several aspects of project analysis are addressed outside of the modeling methodology, primarily in Chapter II. The first is institutional-organizational-managerial aspects, i.e. how well the proposed project will fit into the institutional arrangements of its home site, and how (and whether) it can be organized and managed efficiently. Two other catagories identified by Ripman, and discussed elsewhere in this thesis, are social aspects and commercial aspects. Social aspects include an examination and quantification of possible project externalities, while "commercial aspects...include the arrangements for the marketing of the output produced by the project and the arrangements for the supply of inputs needed to build and operate the project."[16]

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[15] Apedaile, L.P. 1984. Review of Gittinger (1982), in **The Annals of Regional Science** XVIII(2):97.

Ripman's final catagory, economic analysis, looks at a project's overall economic impact on its home region or country and often involves special analysis techniques such as shadow pricing (Wood,1984). Formal economic analysis is not appropriate to the objectives of this study and is not incorporated in the methodology. However, certain aspects of the output of the investment analysis model developed relate to the potential local economic impact of a joint venture in beef-production and are reported in Chapter VII.

To summarize, the research utilises a systems-oriented computer model to address technical, commercial, and, particularly, financial components of project analysis. Institutional-organizational-managerial and social aspects of the hypothetical joint venture are addressed outside the model methodology, while formal economic analysis is deliberately excluded from the methodology. The end result is an approach well suited to the type of small scale privately-financed project examined in this work.

C. VERTICAL INTEGRATION

The concept of vertical integration is a component of marketing theory that is applicable to a system encompassing all stages of beef-production. Firms in many industries integrate vertically to obtain the benefit of either or both of two principal advantages of vertical integration (Bain, 1959).

1. where vertical integration allows economies of production "such that the integrated firm can perform a series of successive production functions more efficiently than they could be performed by a number of individual firms, each of which performed only one function"[17]
2. where vertical integration allows improved coordination between distinct production phases, eg. improved inventory quantity and timing control, elimination of intermediate transactions expenses, and elimination of excess profits of suppliers.

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[16] Gittinger, J.P. 1982. **Economic Analysis of Agricultural Projects.** John Hopkins Univ. Press, Ba. p.16.

[17] Bain, J.S. 1959. **Industrial Organization.** John Wiley & Sons. N.Y., N.Y. p.156.

Several works (including Araji (1975), Henderson and Schwart (1977), Williams and Farris (1975), and Ward (1977)) have documented the existence of economies of vertical integration in beef-production and processing, typically examining the links between cow/calf enterprises, yearling operations, feedlots, and slaughter plants. Although these authors' work is based on the North American beef production complex, it appears applicable to the case under study.

Araji (1975) employed Farrell linear programming and multiple regression techniques to examine economies of scale and production efficiency in western U.S. cattle production systems. He compared three levels of vertical integration in his analysis: cow/calf, cow/calf through yearling, and cow/calf through feedlot, and found that "fixed cost and external economies associated with the 3 systems of beef operation strongly support vertical integration."[18] Henderson and Schwart (1977) and Williams and Farris (1975) also examined the benefits of vertical integration from cow/calf through feedlot. For northern Texas in the mid-1970s, Williams and Farris (1975) reported a profit advantage of approximately $10.00/cwt. to a fully integrated 3-stage enterprise in comparison to separate cow/calf, yearling, and feedlot enterprises, coordinated through the market. According to Henderson and Schwart (1977), the "greatest economic incentive for integration in the cow/calf - feedlot segment lies between cow/calf and growing stages"[19]. The authors noted three primary sources of inefficiency in beef-production which can be eliminated through vertical integration:

1. poor spatial distribution between enterprises.
2. size disparities, increasing cattle assembly costs for feedlots.
3. seasonality of calf production.

Ward (1977) discussed vertical integration between beef feedlots and slaughter plants. He noted the large amount of vertical integration which occurred in the U.S. during the period preceeding his study and cited possible motivation for the increase in feedlot - slaughter integration, noting improvements in "quantity and quality coordination over time and space" due to vertical integration.[20]

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[18] Araji, A.A. 1975. **Vertical Integration and Production Efficiency in Beef Cattle Operations.** Univ. of Idaho College of Ag Bul. No. 553. Moscow, Idaho. p.7.

[19] Henderson, D.R. and R.B. Schwart. 1977. **Vertical Coordination between Beef Cow/Calf Enterprises and Feedlots in the U.S.** WP-13 N.C. Proj. 117. p.50.

Accompanying the trend to feedlot-packer vertical integration has been a trend to more cutting and processing at the slaughter plant site (Hayenga, 1978). Both Ward (1977) and Hayenga (1978), point to definite production effiency benefits from integration, particularly due to the greater efficiencies of transport and marketing for a semi-processed product.

Economies of vertical integration interact with economies of horizontal integration, such that it is not profitable to integrate vertically in a case where the scale of output for one of the links of the chain would be suboptimal (Bain, 1959). Thus ideally, where there are no diseconomies of scale, the scale of ouput of the vertically integrated firm should be matched to the output of the component with the greatest economies of scale. In the case of an integrated beef-production system, that link is most certainly the slaughter/processing/marketing subsystem, where considerable economies of scale exist (Durst and Kuehn,1979). However, since the major reason for economies of scale in beef-packing appears to be due to lower per-head labor costs (Smalley,1978), and since labor costs in China are extremely low, the advantage of large-scale over small-scale processing in China will be less than is the case in North America.

Certainly, a major and difficult to resolve issue in this research is definition of best project size, bearing in mind the interaction between economies of vertical integration and diseconomies of size likely to exist in a fledgeling animal husbandry sector. As discussed in Chapter V, the model designed focuses on a moderate-sized operation, with a small slaughtering facility by North American standards. Such a system was deemed to be the most feasible format for a beef-production in eastern Heilongjiang. Diseconomies of scale in cattle breeding, primarily due to lack of knowledge in practical animal husbandry, are almost certain to occur for the projected final herd size of 10,000 head. However, it is thought that these diseconomies could be largely reduced by distributing the loci of cow calf operations over two or three adjacent state farms, while handling feeding and slaughter/processing in one centralized location.

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[20] Ward, C.E. 1977. **Vertical Coordination of Cattle Feeding and Slaughtering in the Cattle and Beef Subsector.** WP-14 N.C. Proj. 117. p.37.

D. TRANSFER PRICING

Transfer pricing is an important managerial issue for any firm with more than one decision-making unit (responsibility center) (Eccles,1985). Transfer has been studied both with respect to multinational firms with subsiduaries in several countries (Tang,1981), and with respect to vertically and/or horizontally integrated firms in one country (Benke and Edwards,1980). The latter case is more applicable to this thesis, in that all the responsibility centers (components) of the joint venture are to operate under the same institutional and legal framework. The goals of a transfer pricing policy are to maximize retained profits of the firm as a whole by:

1. exploiting differences in legal and tax structures between responsibility centers (for the multinational firm.).
2. eliciting maximum level of performance of the various responsibility centers.
3. achieving effective integration of all of the subunits of the firm into an efficient whole.

Benke and Edwards (1980) describe a "general rule" for transfer pricing policy, along with applications of this rule to various industry structures. Their work was based on a survey of 19 mid to large-size U.S. companies:

TP = SVC + LCM

Where:

TP = transfer price for intermediate good

SVC = standard variable cost

LCM = lost contribution margin

Standard variable cost (SVC) is a "target" average variable cost of production, based on expected standards of performance for that period. SVC is a subjective management decision and will rarely equate to actual average variable cost. Lost contribution margin (LCM) is an accounting term for opportunity cost of not selling that good on the intermediary market.

For the situation where competive markets for intermediary products exist, and the intermediate products do not embody special technology owned by the firm as a whole, the general rule simplifies to transfer pricing at market cost. Indeed, this is the approach to transfer pricing actually adopted by many vertically integrated firms (Eccles,1985). More specifically, it is common for large vertically integrated beef-production firms to price and sell intermediate outputs on a competitive bidding, rather than pre-arranged price basis (Lonnie Wigemyr,pers.com.1987). This practice facilitates better management of individual subunits, since each must be competitive with its counterparts outside the vertically integrated firm.

In eastern Heilongjiang, however, competitive intermediary markets for grass, silage, calves, replacement cattle, and slaughter cattle do not exist; therefore it is impossible to base transfer prices between components of the integrated enterprise (See Chapter IV.) on actual market prices. In this case, according to Benke and Edwards (1980), transfer price should equate to SVC. Far from solving the transfer pricing problem, this leaves firm headquarters with the formidable task of properly and equitably defining SVC.

A transfer pricing policy which does not adequately reflect the contribution of each individual operation can result in faulty resource allocation and serious losses in profitability (Benke and Edwards,1980). Eccles (1985) maintains that the most difficult issue in establishing a firm's transfer pricing policy is to ensure that managers and workers of the various branches feel thay are being fairly rewarded for their contribution to the company.

For the puposes of a study on the feasibility of joint ventures in beef-production, it is recognized that transfer pricing between components of the beef production system is both an interesting theoretical issue and an important and challenging practical concern. Such a conclusion is reinforced by the lack of intermediary product markets for the joint venture. Furthermore, it is felt that the introduction of the "responsibility system", where individual production units in industry are being made more responsible for their performance, and the widespread use of production contracts in the state farm system (Peng,1986), will adopt well to a management incentive based on intra-system transfer prices.

Chapter V explains how transfer prices are set within the computer model of a joint venture in beef-production. In brief, the procedure amounts to equating all IRRs of the five production components through manipulation of transfer prices. A modification of this procedure may have applications in determining an efficient and equitable transfer pricing policy for vertically integrated firms, including the hypothetical joint venture. That possibility is discussed in the final Chapter of this thesis.

E. SUMMARY

The first section of this Chapter establishes the importance of examining a joint venture in beef-production in Heilongjiang as a complex system containing a number of interrelated components. In such a context, the central question of the research is one of systems analysis. The process of systems analysis is to be abetted by a computerized cash-flow model, which facilitates experimentation with various possible designs and allows testing of factors important to financial performance of the joint venture.

In the second section, criteria for project analysis are reviewed. It was decided that the objectives of this particular study are best achieved through detailed financial analysis of the proposed system. Cultural, political, socioeconomic, and other concerns are not addressed in the modeling framework, but are discussed as part of the system's complex environmnot. The resulting approach to project analysis is a cross between standard investment analysis techniques and the broader "project appraisal" approach of Gittinger (1982) and others.

The third section of this chapter highlights the benefits of vertical integration in beef-production systems, but also recognizes the inherent conflicts in project design when two links of the system have differing economies of scale. An argument is presented for a relatively modest sized project, at least initially, due to anticipated diseconomies of scale in cattle breeding.

Related to the concept of vertical integration is the issue of transfer pricing between components of integrated systems. The transfer pricing issue is recognized to be an important theoretical and management issue in this research. Transfer pricing becomes particularly problematic where intermediary product markets are weak or do not exist, as is the case for the proposed joint venture. An IRR-equating criterion is used to set intra-system transfer prices within the computer model used in the research. It is suggested that some application of the transfer price setting procedure employed in the computer model developed may be applicable to vertically integrated firms, as is discussed later in the thesis.

IV. Methodology

The purpose of this chapter is to provide a brief description of the methodology employed to address the objectives of the research (See Chapter I.). The cash-flow model developed is outlined in greater detail in Chapter V, after an introduction in this chapter. The approach to the research problem involved five types of activities:

1. development of an appropriate investment-analysis model.
2. collection of data in China and Canada directly or implicitly incorporated in the model.
3. collection of information in China and Canada important to the research topic, but not incorporated in the model.
4. sensitivity analysis and experimentation with the computer model.
5. organization and reporting of the model results and supplementary information to address study objectives.

A. MODEL

The purpose of the investment-analysis model developed is to provide a vehicle for the testing of impact of changes in technology, prices, and other key variables on the financial feasibility of a hypothetical joint venture in beef-production in eastern Heilongjiang. The model output is financially oriented (as opposed to the production/biological orientation of many of the larger beef enterprise models (see Spreen and Laughlin (eds.),1986)), and the finished product has the following characteristics:

1. a pro forma financial output for 15 years.
2. incorporates improvement in technological performance over time.
3. easy to operate and modify.
4. portable and operable on computing equipment widely available outside the North American university environment; specifically, IBMpc-compatable equipment.
5. adaptable to other beef-production or food processing studies.

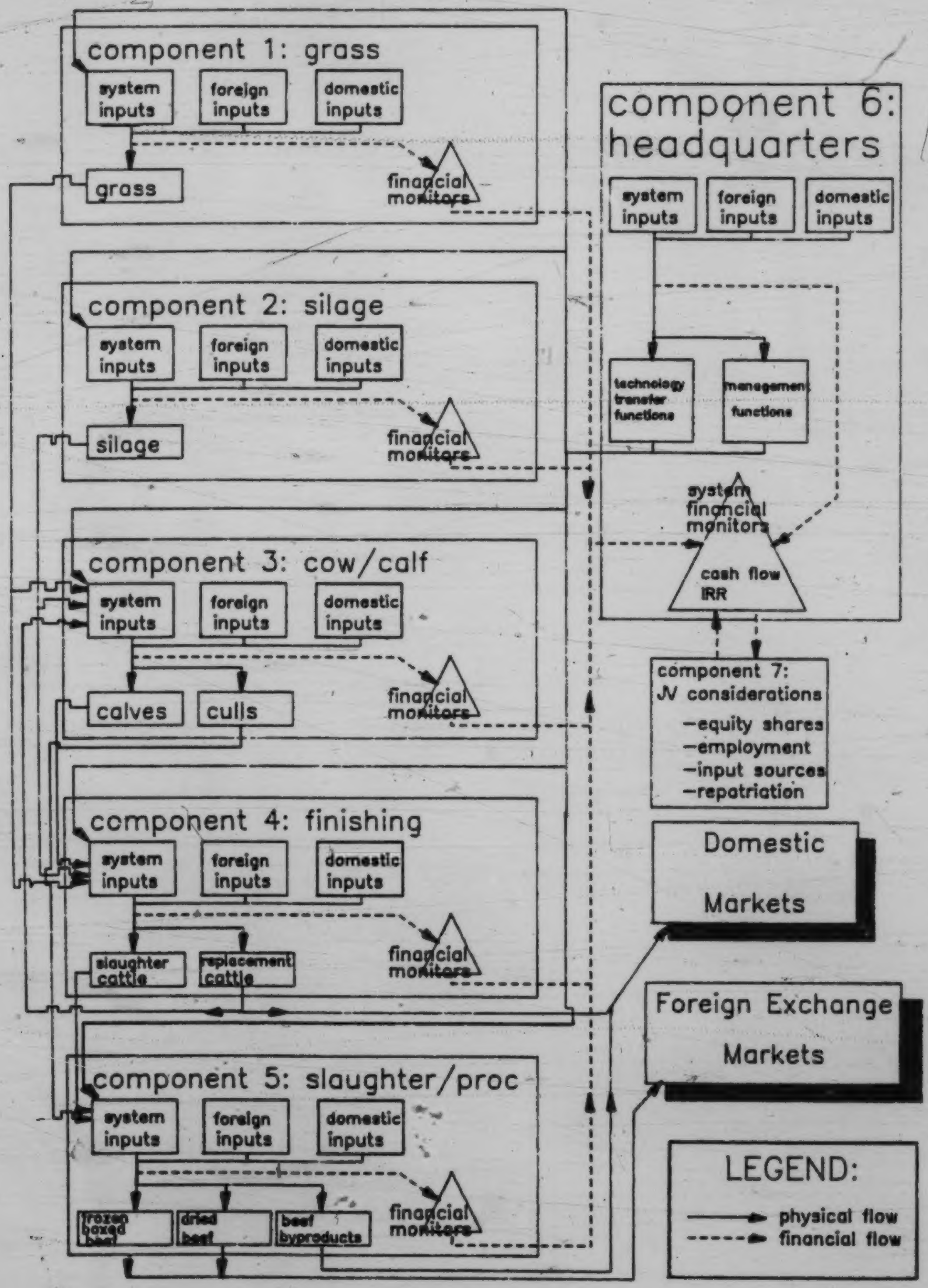
The format chosen, that meets these criteria was an electronic spreadsheet using LOTUS 123™. The spreadsheet developed approaches memory capability limits of IBMpc compatable machines, but is capable of handling all financial and production relationships, both within components and between components, at the level of complexity warranted by the scope of this study, and within its data constraints.

As outlined in Figure IV.1, the beef-production model or system is comprised of seven interrelated "components". All of the components, with the exception of Component 2, are further subdivided into "parts". Components 1 through 5 deal with the production process and are: 1 - Pasture, 2 - Silage, 3 - cow/calf, 4 - finishing, and 5 - slaughter/primary processing. Component 6 is responsible for "headquarters functions" for the project and includes a calculation of costs and returns for the entire integrated production process, including management and operating costs applicable to the enterprise as a whole. Finally, Component 7 addresses joint venture issues, which would become important if substantial foreign investment in such a project were to take place.

The vertical dimension (rows) of the spreadsheet describes technological and financial constants for each of the seven systems. It also includes technological and financial parameters which are calculated from simple mathematical formuals that attempt to capture the essence of the production process. Detailed biological feedback loops are not applicable nor necessary for the type of investment-analysis model developed, particularly considering time and data constraints for this project.

The horizontal dimension (columns) contains values for each of the constants and calculated values for each year of the 15-year lifespan of the project. Over project lifetime, there are two possible ways of dealing with technological transformation rates. One approach is to use the input-output analysis assumption of no technological change, maintaining the same production "recipe" for all 15 years. A more plausible approach is to assume that there will be improvements in all technological transformation rates over time and impose "technological improvement functions" (TIFs), functions which describe the behavior of a technological coefficient over time. The latter approach is adopted in this model and the key paramaters of these TIFs are stored in a separate section of the spreadsheet to facilitate simulation of different levels of technology and different rates of technological improvement.

Figure IV.1: Design of an Integrated Beef Production System in Heilongjiang.

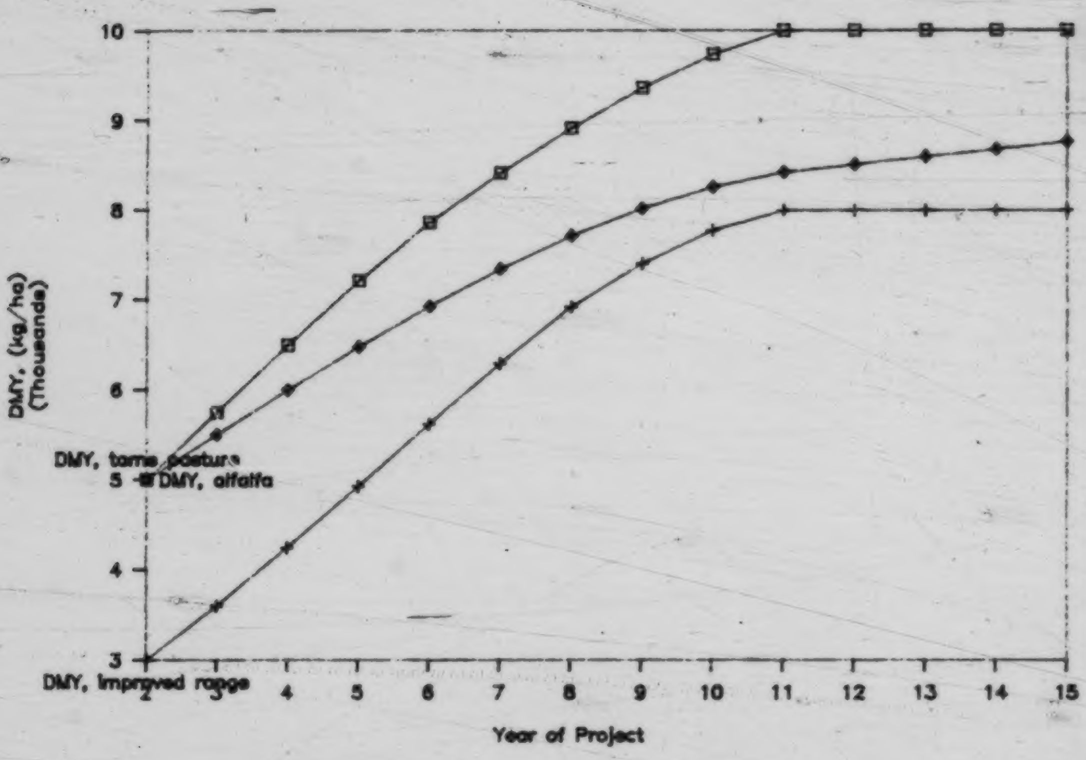

component 1: grass
system inputs
foreign inputs
domestic inputs
grass
financial monitors
component 2: silage
system inputs
foreign inputs
domestic inputs
silage
financial monitors
component 3: cow/calf
system inputs
foreign inputs
domestic inputs
calves
culls
financial monitors
component 4: finishing
system inputs
foreign inputs
domestic inputs
slaughter cattle
replacement cattle
financial monitors
component 5: slaughter/proc
system inputs
foreign inputs
domestic inputs
frozen boxed beef
dried beef
beef byproducts
financial monitors
component 6: headquarters
system inputs
foreign inputs
domestic inputs
technology transfer functions
management functions
system financial monitors
cash flow
IRR
component 7: JV considerations
—equity shares
—employment
—input sources
—repatriation
Domestic Markets
Foreign Exchange Markets
LEGEND:
physical flow
financial flow

Technological Improvement Functions

Since values of technological coefficients have a large impact on the financial coefficients of the model, it is worthwhile to describe the TIF section of this model in greater detail, noting simplifying assumptions. There are 23 basic TIFs in the model, as shown in Table IV.1, covering the gamut from dry matter yield of unfertilized tame pasture, to labor requirements of beef processing. All functions have a starting value, as of Year 2 or 3 of the project, and a maximum or minimum limit value, based on perceived genetic, physical, and management constraints. In the Base Scenario, starting values of TIFs are near current levels of Heilongjiang technology. This assumes that initially there will be many problems in the application of Canadian technology to China, which collectively will impede enterprise performance in early years. Limit values, conversely, are generally set to a level of performance roughly equivalent to the "average" Alberta producer/processor. Exceptions to the above-noted procedure are noted in the discussion of TIF choice in this chapter. Limit values would be attained in the final years of a well-managed project which successfully implements western technology in beef-production and processing. In the absence of directly applicable data on functional form, the TIFs are assumed to be increasing at a decreasing rate until limit values are attained, and constant once limit is attained. The lowest rate of improvement for all TIFs will be 1.0% in Years 11 to 15 of the project. The 1% rate of technological improvement is equivalent to the estimated historical overall rate of technological improvement in the Alberta beef industry from 1960 to 1983 (Marv Anderson & Associates,1985). Figure IV.2 plots the TIFs for dry matter yields of tame pasture (Part 1,1), improved range (Part 1.2), and alfalfa (Component 2). The diminishing rate of technical improvement approach assumes that the greatest benefits from technology transfer would occur in the first few years of a project and that improvement rates during the latter part of the project would be closer to improvement rates for average Alberta operations.

The 23 TIFs chosen were intended to represent important variables in the beef-production process that are most likely to respond to the introduction of western technology and management systems. Other important variables were included in the model

Figure IV.2: Plot of Grass and Silage Production Technological Improvement Functions Over Project Lifetime.



design as constant relationships, based on the judgement that they were less likely to demonstrate significant response to technology transfer than the 23 variables chosen. The following paragraphs explain the choice of TIFs and TIF key parameters in greater detail.

Components 1 and 2

For grass and for alfalfa silage production, dry matter yield (DMY) is the most important variable, and should be relatively responsive to improvements in technology and management. A separate TIF is given for each class of forage: #1.11 - tame pasture, #1.21 - improved range, and #2.01 -alfalfa silage. Starting and limit values are based primarily on results of forage test plots on State Farm 852 (Appendix A), and on personal observation of the range sites. Intensive management and seeding of productive tame species would be necessary to achieve limit values for forage dry matter yields.

Table IV.1 Key Parameters of Technological Improvement Functions for the Cash-Flow Model.

					IMPROVEMENT RATE									
#	NAME	UNIT	START	MAXIMUM	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9	YR10	YR11-15
1.11	DMY TAME PASTURE	kg/ha	5000.00	10000.00	0.15	0.13	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.01
1.21	DMY, IMPROVED RANGE	kg/ha	3000.00	8000.00	0.20	0.18	0.16	0.14	0.12	0.10	0.07	0.05	0.03	0.01
2.01	DMY ALFALFA SILAGE	kg/ha	5000.00	10000.00	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01
2.03	CP CONTENT	%	15.00	18.00	0.05	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
2.05	SILAGE WASTE	%	12.00	6.00	-0.15	-0.13	-0.11	-0.09	-0.07	-0.05	-0.04	-0.03	-0.02	-0.01
3.11	BIRTHWEIGHT, bc	kg	35.00	45.00	0.06	0.05	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01
3.13	ADG, bc	kg	0.70	1.00	0.10	0.08	0.06	0.04	0.03	0.02	0.01	0.01	0.01	0.01
3.14	WEANING RATE	%	80.00	95.00	0.05	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
3.21	HERD GROWTH	%	1000.00	10000.00	1.00	0.80	0.60	0.50	0.40	0.30	0.00	0.00	0.00	0.00
3.23	COW MORTALITY	%	5.00	1.50	-0.25	-0.22	-0.19	-0.15	-0.11	-0.07	-0.04	-0.03	-0.02	-0.01
3.25	CULL COW LIVEWEIGHT	kg	450.00	550.00	0.05	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
3.31	CONCEPTION RATE	%	65.00	80.00	0.05	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
4.11	ADG, wB	kg	0.80	1.30	0.12	0.10	0.08	0.06	0.04	0.03	0.02	0.01	0.01	0.01
4.15	MORTALITY;4.1,4,2	%	5.00	2.00	-0.20	-0.17	-0.14	-0.11	-0.09	-0.06	-0.04	-0.03	-0.02	-0.01
4.16	MORTALITY;4.3,4.4	%	2.00	1.00	-0.15	-0.13	-0.10	-0.08	-0.07	-0.05	-0.04	-0.03	-0.02	-0.01
4.31	ADG, yS	kg	0.70	1.10	0.10	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.01
4.41	ADG, lS	kg	0.70	1.10	0.10	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.01
5.11	STEER DRESSING %	%	56.00	61.00	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
5.13	FINISHING %	%	46.00	51.00	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
5.15	WASTE & SHRINK	%	30.00	25.00	-0.05	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
5.21	DRY BEEF YIELD	%	45.00	50.00	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
5.22	LABOR RQMT, SLTR	mhr/hd	4.00	2.00	-0.15	-0.11	-0.09	-0.08	-0.07	-0.05	-0.04	-0.03	-0.02	-0.01
5.33	LABOR RQMT, PROC	mhr/hd	8.00	5.00	-0.10	-0.08	-0.07	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01	-0.01

Silage crude protein content (#2.03) was chosen as a TIF because crude protein level is an important variable acting on cattle performanc in Component 4, and because better harvest and storage technology should result in improvements in silage crude protein with time. The 15% starting crude protein level corresponds to low to medium quality alfalfa silage, according to NAS-NRC data. Similarly, 18% crude protein can be considered as an upper limit for early-cut, well-preserved alfalfa silage.

Silage waste (#2.05, is a relatively minor variable, but another aspect of the silage-production process deemed to be sensitive to improvements in technology and management. The start and minimum values chosen represent a range between wasteful open-storage practices and well-designed, carefully covered bunkers (Fullen,1981).

Component 3

Seven TIFs were chosen to represent aspects of the cow/calf system most likely to change through the introduction of western management and genetics. The TIFs chosen for Component 3 can be roughly subdivided into two groups: 1.) TIFs, the improvement of which, would be likely to be predominantly due to genetic improvements, and 2.) TIFs which would be more likely to be primarily influenced by improvements in management, particularly improved nutritional management, than by genetic factors.

Only two TIFs, bull calf and cull cow liveweights (#3.11 and #3.25), fall into the first catagory listed above. Neither of these two variables are likely to have a major impact on overall productivity of the beef-production system. The weight ranges chosen represent current typical birthweights and liveweights for Heilongjiang and Alberta respectively.

Although bull calf average daily gain (ADG) (#3.13) would increase with improvements in genetics, it is thought that the largest increases would be likely to come from improvement in nutritional environment and overall cattle management. As is the case for all TIFs in Component 3, the range of values chosen follows closely the general principal of current Heilongjiang starting levels and current "average" Alberta limit values.

Weaning rate (#3.14) and conception rate (#3.31) were deemed to be the two aspects of reproductive efficiency most important to enterprise success, and most likely to respond to improvements in management. It was also anticipated that cow mortality (#3.23) would respond dramatically to improvements in cattle management and nutritional regime. The TIF for herd growth (#3.21) does not reflect any improvements due to technology transfer.

Component 4

There are two types of TIFs in Component 4 (finishing). The first group of TIFs is for ADG of the seperate finishing activities, as described in Chapter V (#4.11, #4.31, and #4.41). Average daily gain would be the most critical aspect of Component 4 performance. Another important feeding variable, feed conversion ratio, was deemed to be less likely to change significantly over time, and was therefore incorporated in the model as a direct function of ration characteristics and animal class and weight. The starting levels for ADG in all three TIFs are only marginally superior to ADG under "backgrounding" rations in Alberta. Limit levels are more ambitious targets, representing improvements in both nutritional management and beef genetics, but are still relatively conservative in comparison to typical Alberta performance levels (Smith,1981).

Mortalities are an important aspect of feeder cattle performance likely to decrease as management improves. There is one TIF for weaned to yearling-age animals (#4.15), which is higher than the TIF for one to two-year-olds (#4.16). Starting levels are arbitrary assessments of likely mortalities in newly-introduced finishing systems. Limit mortality levels are from 1/4 to 1% higher than typical Alberta levels for that age category (Smith,1981).

Component 5

Slaughter and processing technology is primarily physical transformation technology and should be transferred more rapidly than technology in the other four components. Consequently, the range of improvement given for Component 5 TIFs is relatively narrow. Dressing and finishing percentages are the two most important "improvable" variables in the slaughter/processing component. The preceeding claim was reinforced by results of the sensitivity analysis of the cash-flow model (Chapter VI.). Improvement in dressing percentage is anticipated to be largely attributable to improvements in carcass fleshiness, from better nutrition and the introduction of beef genetics. Improvements in finishing percentage would also be attributable to improved carcass characteristics, but, equally important would be the refinement of cutting technology, to incorporate recent advances in both cutting and packaging of beef. Lower levels for dressing and finishing percentages should be readily attainable, but the upper levels represent relatively high performance levels in the context of the Canadian carcass retail system (Kennedy and Churches,1981), and would be attainable in an efficient plant where meat was cut and packaged on-site for shipment as frozen primals.

Waste and shrink percentage (#5.15) inversely reflects yields of saleable byproducts, and is of less importance than the other Component 5 TIFs. A slight improvement over project lifetime would be possible, due to improvements in byproduct use and overall management efficiency in the slaughter facility.

Dry-beef yield (#5.21) reflects the efficiency of processing of dry-beef and is expected to improve slightly due to refinement of drying technology and decreases in wastage. Starting and limit values were based on an interview with an industry source.

Finally, the assumption was made that improvements in overall management efficiencies would be likely to reduce per head slaughter and processing labor requirements (#5.22 and #5.33) dramatically. Starting levels for labor requirement TIFs are estimates, while limit levels are approximately twice as high as for similar facilities in Alberta (Alberta Agriculture,1982).

Model Design

Figure IV.3 is a diagramatic representation of how the cash-flow model works. Financial values generated by this model are typically products of technological coefficients and prices. There are two types of prices used in the model, exogenous prices and endogenous (transfer) prices. Exogenous prices include wage rates, fertiliser prices, and land rental fees on the input side, and the price of frozen boxed beef, hides, and replacement heifers sold to other farms on the output side. As much as possible, exogenous prices are based on data collected during field work in China. As is demonstrated in the Results section of this study, exogenous prices, and particularly output prices, have a large impact on key financial parameters for the project as a whole. Endogenous prices, conversely, have no effect on project IRR, but can have a large impact on distribution of profit among the individual systems. Both Chinese and Canadian investors will be more concerned with System IRR than the financial performance of specific subunits. The main benefit of individual system financial statements would be as a management tool to monitor the relative performance of various subunits of the integrated enterprise and as a means of incorporating financial incentives for improved performance. Note that in the Base Scenario, all prices are held constant over the lifespan of the project, on the assumption that general inflation will affect input and output prices equally.

The key financial output from this model is internal rate of return (IRR) for each of the first 6 components, and various measures of financial efficiency in Component 7. Managers of state enterprises interviewed in China appeared to be very interested in the following statistics: output per worker, profit per worker, output per mu,[21] and profit per mu. Consequently, these values, along with output and profit per head of breeding cattle, are tabulated in Component 7, and are useful for purposes of comparison of performance between alternative constructs for a beef project and existing state enterprises. Other financial parameters and ratios generated in Component 7 are important to the feasibility decision and are discussed in the next Chapter.

The primary purpose of the spreadsheet developed is to allow the systematic determination of how changes in values of technological and financial constants might affect key financial paramaters of a joint venture in beef-production.

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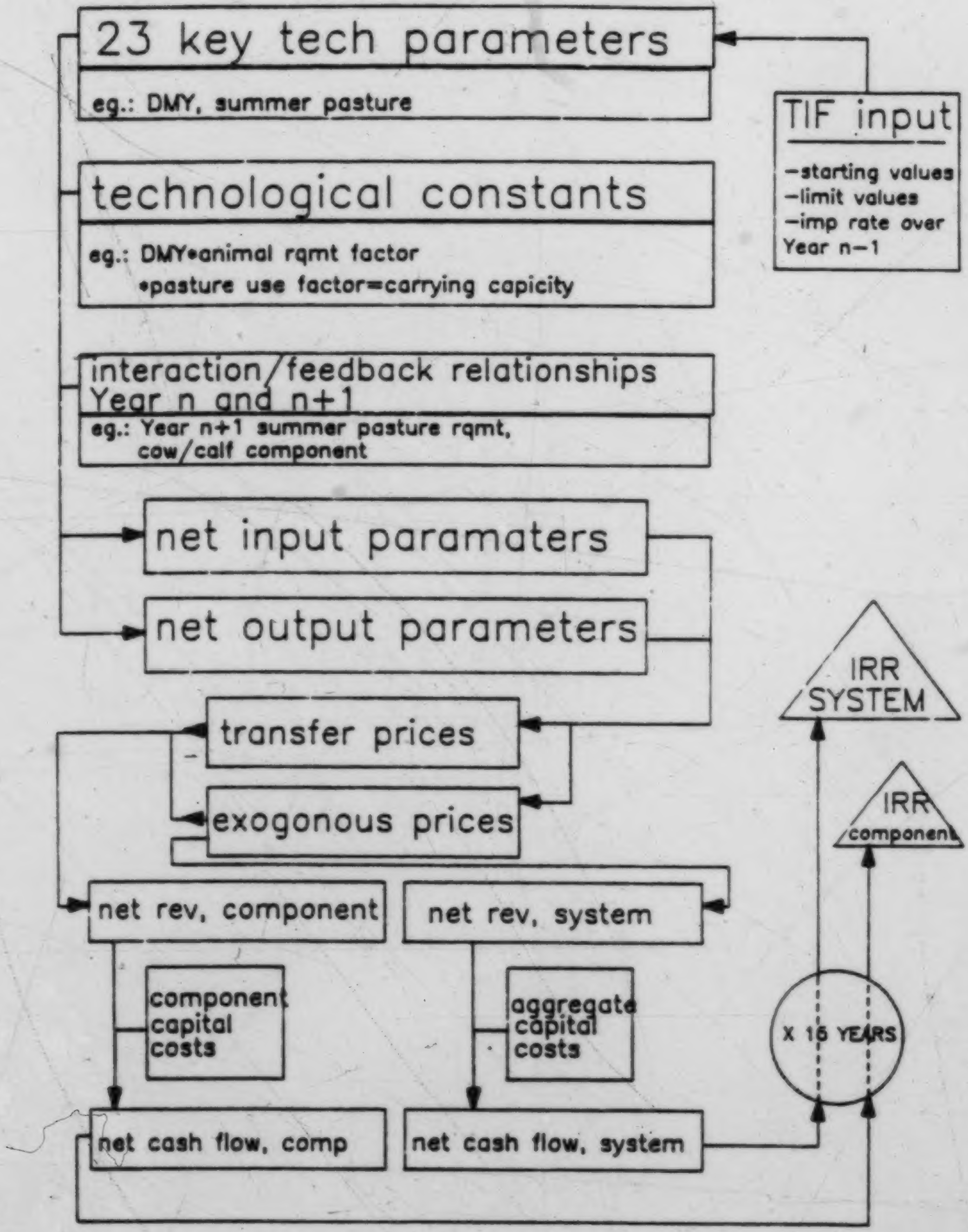
[21] A *mu* is a unit of area equivalent to 1/15 of a hectare.

Figure IV.3: Basic Operations of the JV Cash Flow Model.


23 key tech parameters
eg.: DMY, summer pasture
TIF input
-starting values
-limit values
-imp rate over
Year n-1
technological constants
eg.: DMY•animal rqmt factor
•pasture use factor=carrying capicity
interaction/feedback relationships
Year n and n+1
eg.: Year n+1 summer pasture rqmt,
cow/calf component
net input paramaters
net output parameters
IRR
SYSTEM
transfer prices
exogonous prices
IRR
component
net rev, component
net rev, system
component
capital
costs
aggregate
capital
costs
X 15 YEARS
net cash flow, comp
net cash flow, system

B. DATA COLLECTION

As noted in the introduction to this chapter, two types of data were collected for this research project, namely:

1. data directly or implicitly incorporporated in the investment-analysis model.
2. information relevant to the topic but not incorporated in the model.

The data collection process itself was divided into two stages:

1. data collection in China, and
2. data collection in Canada.

Data Collection in China

The principal method of information collection in China was by interview through interpreters. During the time spent in China a total of 29 interviews were conducted. In order to broaden the database for this study, as wide as possible range of sources were chosen, and whenever possible two or more "experts" in a field were consulted. An attempt was made to gather information applicable to all facets of a joint venture in beef-production, resulting in a considerable diversity of sources of information. People interviewed included professors and panels of professors; factory and enterprise managers; state farm managers, accountants, and technicians; market managers; and employees of the HGB. Some of the information collected during interviews came directly from farm records and published documents the iterviewee had with them at the time. More typically, the person being interviewed would offer information or answer questions based on writings in pocket notebooks, or from memory.

A certain amount of information collected in China was through the efforts of teachers, professors, and interpreters, who collected, and summarized in English, material written in Chinese. This included weather data, farm financial records, university and HGB financial records, and excerpts from published sources in China.

Finally, information was gathered from direct observation, including information on market prices for meat products.

Numerical data collected in China, directly applicable to model data requirements, included:

1. state and free market prices for inputs and outputs.
2. estimated and actual costs of capital items, including machinery and buildings for agriculture and food processing industries.
3. costs and returns for typical state farm farming operations.
4. productivity estimates for key paramaters in forage production, beef and dairy production, slaughter, and meat processing.

Information collected in China, peripheral to model data requirements, but directly relevant to the research project, included:

1. HGB and individual state farm resource assessments.
2. HGB structure and organization.
3. infrastructure assessments.
4. byproduct market assessment.
5. region specific information on climate, soils, forages, and cattle production.
6. foreign and especially Canadian involvement in the HGB.
7. general interest in joint ventures in beef production.

Important limitations of the data collection process, particularly relative to Chinese data are summarized in Chapter VI.

Data Collection in Canada

Information collection in Canada occurred both before and after the China field trip. Types of information collected included:

1. published and unpublished estimates of technological coefficients in the Alberta beef industry.
2. identification of pertinent and transferable technology and expertise.
3. assimilation of information, experiences, and impressions from Canadian firm and government representatives who have been involved in Chinese agriculture, with emphasis

on beef and forage sectors (Refer also to Appendix C.)

4. collection of information on pertinent federal and provincial government support programs (See Appendix D.)

Information was collected through telephone and personal interview, and from numerous written sources. A listing of some individuals contacted for the purposes of this study is included in Appendix E.

C. ANALYSIS

Sensitivity Analysis

The nature of the model employed and data gathered for this study precludes formal statistical analysis of raw data. For example, for many paramaters of the model, particularly input prices, only one value was available, the official 1986 state price (See "Limitations". section of Chapter VI.) As a result, formal analysis is confined to sensitivity testing of key paramaters and assumptions, within the model framework. The sensitivity analysis procedure could be summarized as follows:

1. Establish model Base Scenario (See Chapter V.).
2. Identify assumptions to be tested.
3. Stepwise, systematically vary paramaters to test the chosen assumptions, noting the effect on key financial output of the model (specifically, on component and Project IRRs.).
4. Summarize results and identify the most important assumptions.

The key assumptions tested in this model were:

1. TIF starting values.
2. TIF limit values.
3. assumption of technological improvement over project life.
4. input prices.
5. output prices.
6. capital costs.

7. exchange rate.

A separate sensitivity analysis was conducted for each class of assumptions. Assumptions relating to TIFs were tested on a component by component basis to isolate the effect of changes in baseline assumptions within specific components of the project. Financial assumptions were tested globally.

Experimentation

Following sensitivity analysis, the model was used as a systems design tool in a series of experiments. A total of eight experiments, involving changes in project design or baseline assumptions were conducted and reported on. The experiments chosen test the impact of changes in system design or the impact of changes in assumptions about system environment. The experiments were intended to address a number of questions which arose during the model construction and sensitivity analysis parts of this study. The following is a listing of experiments conducted:

1. Project Structure Experiments:
    a. Continuous Expansion.
    b. Joint Venture Extension.
2. Technical Management Experiments:
    a. No Steers.
    b. No Sale of Replacement Heifers Off-Farm.
    c. Boxed Beef Only (no dried beef).
3. Financial Environment:
    a. Varying Exchange Rates.
    b. Impact of Government Grants.
    c. No Herd Buy-out.

The methodology of these experiments is presented in Chapter VI.

V. State Farm Beef Production Cash Flow Model

This chapter presents a description of an electronic spreadsheet model of a hypothetical integrated beef production enterprise on a state farm in Heilongjiang. This description is a detailed component-by-component explanation of the program and the management systems and technologies which form the basis for the Base Scenario of the model. For a concise definition of technical constants, abbreviations used in model hardcopy, and management strategies of the components, the reader should refer to model comments in Appendix F.

A. MODEL DESCRIPTION AND BASIC MANAGEMENT SYSTEMS

The spreadsheet model employed in this study is based on a conceptualization of a state farm-based joint venture in beef-production. The hypothetical enterprise and its management components are the product of a synthesis of information from dozens of sources over a prolonged period, particularly taking into account such factors as the strengths and weaknesses of relevant Canadian and Chinese industries, resources, and infrastructure, and the experiences and suggestions of interested parties. The China field work was particularly valuable for the synthesis process. Since these conceptions of technology and management systems are integrated intentionally and unintentionally into the model itself, it is logical to discuss management systems for the Base Scenario at the same time as the model itself is outlined in detail. What follows, therefore, is a component-by-component description of the spreadsheet model, in conjunction with a description of the project's Base Scenario management systems.

The outlined management system is a hybrid of labor-intensive Chinese methods with advanced western technology. Li (1987) found that western grain production technology was not separable from its labor saving bias. The same observation is likely to be true for Component 2 (silage) technology. However, much of the beef-production, slaughter, and processing technology to be imported should be readily adapted to labor-intensive production.

Each component of the beef-production system would be managed separately under the guidance of overall project management. Project managers would have the goal of ensuring maximum benefits from vertical integration by combining the separate components effectively into the overall production plan. Effective integration would be facilitated by the use of production contracts between components.

Unless otherwise stated, values for key technological parameters are derived directly from TIF parameters according the the following formula:

$P = P_{n-1} + P_{n-1} \cdot I$; IFF $P <= L$

Where:

P = value of parameter in Year n.

P_{n-1} = value of parameter in previous year.

I = improvement rate for year of the production process.

L = limit value.

Starting values, limit values, and improvement rates for the 23 TIFs of the Base Scenario are listed in Table IV.1 of the previous chapter.

Component 1: Pasture

The sole purpose of Component 1 is to produce forage for grazing ("grass"). The use of this forage is paid for by Components 3 and 4 in the form of per animal unit month (AUM) grazing fees. Component 1 is not responsible for management of the cattle which graze this pasture, but a contract or other form of understanding would ensure that prescribed pasture rotations were followed.

Component 1 is composed of two parts, 1.1 and 1.2. Part 1.1 involves the production of tame forage species best suited to early and late season grazing, seeded mechanically on "prime" sites of former native grassland. These "prime" sites are well drained level areas near enterprise headquarters. They would give good yield response to intensive pasture management and be suitable for mechanical seeding, harrowing, and fertilization with animal wastes. Furthermore, because of their seasons of use, during non-peak periods of precipitation, and their topography, these sites would not be prone to periodic flooding problems.

Part 1.2 could be termed "semi-improved range", and would consist of good but not prime lowland grasslands with tame summer-season forages seeded by non-mechanical methods. A probable system for pasture development would be burning, followed by broadcast seeding and intensive grazing to trample the broadcast seed. The goal would be to introduce forage species more productive and palatable than the native species. Costs of development and maintenance of this pasture type are lower than for 1.1. Range type 1.1 is more apt to experience occasional waterlogging problems and therefore represents a possible production risk.

Both parts would be operating on currently unused lowland range types, as described in Chapter 2. Since the opportunity cost of this land is nil, and the project would be developing these areas, perhaps rendering the better sites fit for inclusion in the state farm cropping rotation, there is a strong argument for the joint venture not paying a land rental fee. This is the assumption in the Base Scenario for Component 1.

The dry matter yield (DMY) for Part 1.1 is based on a diminishing rate of improvement TIF, the starting and limit values of which are based in part on forage variety test results on state farm 852 (See Appendix A.). Implicit in the TIF for Part 1.1 is the yearly application of manure collected from feeding areas in Component 4. The DMY for part 1.2 is lower than 1.1, primarily because terrain problems may preclude intensive management such as manure spreading and mechanical reseeding.

Pasture area requirements are balanced to seasonal grazing requirements of Components 3 and 4, based on utilization rate, yield, and a monthly intake factor of 450 kg/AUM. Part 1.1 is assigned a utilization rate of 70%, to coincide with its intensive management, while the utilization rate for Part 1.2 is set at 50%. Newly seeded area is based on projections of yields and forage demand for the following year[23]. There is an excess of grass-production in the latter years of the project, since DMY increases while herd size remains static, and land is not removed from Parts 1.1 and 1.2.

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[23] Forage use factors: yearling=0.7AUM; cow & calf=1.0AUM; bull=1.25AUM.

Recurrent inputs in Component 1 are labor and pasture maintenance and renovation expenses. Capital investments for Component 1 include access road construction, drainage, forage establishment, fence construction, water development, and machinery for pasture maintenance and development. Capital costs allocated for Part 1.1 are higher than for 1.2 to account for the higher costs of mechanical seeding methods used to develop the "prime" range sites of 1.1. However, to considerably reduce risks of production for Part 1.2 would likely necessitate a capital investment substantially higher than that allocated under the Base Scenario.

Component 2: Silage

Component 2 models the production and storage of winter fodder for use by Components 3 and 4. Silage is preferable to hay for a number of reasons: higher rates of gain are possible, its labor intensive production is well suited to state farm resources, weather risk is reduced, and it is possible to feed efficiently to slaughter weight on a high-silage ration.

Component 2 has no parts and is intended to model silage production from alfalfa. It would be possible to include subdivisions for other silage crops, but alfalfa has high production, excellent feed value, and maximum soil benefits, best complementing other state farm crops (See Chapter II.). Land used for silage production would be state farm cropland, and the joint venture would pay the state farm a per hectare fee, comparable to the annual fee paid by family farmers who utilize similar land. Land would be readily transferred from Component 2 to the state farm, and vice versa. A four-year cropping cycle, with an average of 2.25 cuts per year, is anticipated (two cuts in first 3 years; 3 cuts in final year).

Silage production (DMY) is modeled as a function of yield potential and fertiliser (P_2O_5) application. The DMY function is:

$X = D + .002\,D\,f - .016\,f^2$

Where: X = actual dry matter yield (DMY), (kg/ha)

D = yield potential, no fertiliser[23]

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[23] based on a TIF.

f = fertiliser application, actual P_2O_5 (kg/ha)

A similar functional form, based on research trials, was employed in a study by Lovering and McIsaac (1981). The coefficients chosen are arbitrary since there is no locally-applicable data for alfalfa response to phosphorous fertiliser. The preceeding fertiliser response function was chosen because it embodies the principle of diminishing returns and generates plausible results. The TIF for yield potential, D, is based, in part, on test plot results from state farm 852 (See Appendix A.). Fertiliser use in the Base Scenario is 50 kg/ha, P_2O_5 basis. A second TIF denotes silage waste during both harvest and storage, which decreases at a decreasing rate.

Silage requirements of Components 3 and 4 are equated to Component 2 production less wastage. New land is seeded to alfalfa to balance the following year's requirements, taking into account land returned to the state farm cropping rotation.

Recurrent inputs to Component 2 are land use fees, labor, machinery operation, and fertiliser. Capital requirements include seeding and harvest equipment, a machine shed/shop, and silage storage facilities. Capital costs of seeding and harvesting equipment were based on approximate current (1986) costs of Canadian sourced machinery plus a 40% premium for inflation and transport to China. The same procedure was employed for costing of all foreign-supplied capital inputs to the project.

Gross revenue for the silage component is a product of silage DMY less waste, multiplied by the transfer price for silage, which in turn is a function of silage quality (as measured by crude protein (CP) content). Silage crude protein content is the third TIF for Component 2. Medium quality silage (MQS) is defined as silage with a crude protein content of between 15 and 16.5%. Medium quality silage is sold at a lower price than high quality silage (CP>16.5%).

Component 3: Cow/calf

The primary product of Component 3 is weaned calves for sale to Component 4, but sales of culled animals to Components 4 and 5 is also an important source of income. Component 3 is complex, and subdivided into two parts, which are: 3.1 - calves and 3.2 -

breeding herd.

Part 3.1 includes values for the technical coefficients important in calf production, including weaning rate, and birthweight and average daily gain (ADG) for bull calves. Values for steer and female calf performance are relative to bull calf performance[24]. In the Base Scenario, 50% of cattle born are male and 50% of these are castrated shortly after birth, to facilitate two different finishing strategies (See See Component 4 discussion.).

Part 3.2 attempts to model the herd dynamics of the proposed project. The herd development strategy is based on use of local dairy-herd heifer calves plus in-herd replacement heifers, artificially inseminated with semen from Alberta beef bulls, to produce a final beef herd containing a sizeable percentage of holstein genetics. The Chinese "black and white" dairy breed is composed of a combination of European holstein and Yellow Cattle genetics. The strategy outlined above is based on the following rationale:

1. State farms on the Three Rivers Plain collectively have a sizeable and increasing dairy herd (about 35,000 head in 1985,(GBSFH,1986)).
2. As state farm dairy herds near target size in the next few years more female calves will become available.
3. Dairy-type genetics have been demonstrated to be potentially valuable contributors to productive beef herds (Berg,1986).
4. Importing live beef cattle from Canada is an unattractive option due to:
    a. severe animal health protocol restrictions, delays, and difficulties.
    b. prohibitively high expense of importation.
    c. infrastructural problems in handling and shipping live cattle.
    d. possible incompatability with local nutrition and husbandry.
5. A combination of factors favor the use of AI for herd development on state farms in Heilongjiang (See Chapter II.):
    a. reasonably good facilities and infrastructure for AI, including Canadian development aid.

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[24] Female calf birthweight=90% male birthweight; ADG, steer calf=90% bull calf; ADG, heifer calf=85% bull calf.

b. large pool of inexpensive manpower, including personnel trained in AI.

c. demonstrated positive track record with AI use, particularly in dairy herd development on state farms[25].

The proposed herd development strategy and herd growth modeling approach is flexible with regards to location and ownership of the breeding animals. In the Base Scenario, the breeding herd would be carried on pasture on two or more state farms, and the joint venture entity would claim ownership to all animals. Another possibility, however, is "family - farm" owned animals run communally on "community pastures" pastures managed by the joint venture.

For the Base Scenario, herd starting size is 1000 head (breeding cows) and increases rapidly, but at a decreasing rate, until target herd size of 10,000 is attained in Year 7. Removal rates of cows from the herd are highest in early stages of the project, when animal quality is anticipated to be poorest. For the Base Scenario herd growth rate, it is necessary to introduce large quantities of heifers from outside the system during the first several years of the project. As previously mentioned, the source for these outside replacements is local dairy herds. Replacement heifers would be bought young and raised under a high energy ration (in Component 4) to facilitate breeding as yearlings. HGB cooperation in dairy calf procurement would be essential for the success of the herd development strategy outlined above.

The measurement of reproductive efficiency in the model is determined as follows:

1. Conception rate (a TIF) = pregnant cows, Oct. 1/herd size.
2. Birthrate = cows giving birth/(1) = 0.95, a constant.
3. Weaning rate (a TIF) = calves weaned/live calves born.

Actual cull rate is constant at 10%, but there is also a much larger "removal rate", equivalent to 1-conception rate, i.e., all cows which fail to conceive are culled from the herd.

Key technological transformation rates in Part 3.2, in addition to herd growth rate, are spring cow liveweight, mortality, and conception rate. These TIFs reflect the progress of the hypothetical joint venture in adopting western beef-production practices. Technological improvement function values for Component 3 for project lifetime are listed in Table V.1. The model generates yearly pasture requirements for Component 1, and winter ration requirements which feed back to Component 2. A heavy emphasis is placed on use of tame pasture resources, to reduce feeding costs for the component.

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[25] This opinion was based on visits to AI-bred beef and dairy herds on state farms, and a visit to the Animal Breeding Center of Heilongjiang.

There are two important areas in which the management component for this hypothetical enterprise differs from those employed in commercial beef herds in Alberta. The first is that, in the Base Scenario, 50% of male calves are not castrated, so as to benefit from the higher productivity of bull calves and feeders (Crotty,1980). The second important difference is that the proposed herd management system is relatively labor-intensive, as compared to the "extensive" cattle management style of Alberta producers. A labor-intensive herd management strategy is intended to take advantage of the large pool of low-cost trainable manpower available in Heilongjiang, and the large numbers of graduates from technical programs in animal husbandry and artificial insemination courses. The breeding component of the Base Scenario is primarily AI, because it is more expensive to import, select, raise, and maintain bulls than to provide sufficient manpower to ensure efficient heat detection and a reasonably high AI success. The predominantly AI component is also an efficient and rapid method of improving herd genetics and therefore enterprise profitability. The Base Scenario assumes no bull importation and use of in-herd "clean-up" bulls at a cow to bull ratio of 50:1, following a six week AI breeding season.

Recurrent inputs for Component 3 are pasture and winter feed, supplementary inputs, semen and AI supplies, and personnel. Capital requirements include corrals, shelters, feeding and watering equipment, and the breeding herd itself. The purchase of replacement cattle and the sale of culls are treated as adjustments to the herd inventory, which is evaluated as of January 1 of each year. The breeding herd represents a special case of capital asset. Unlike mechanical and structural assets which are assumed to have zero salvage value as of Year 15, the breeding herd is steadily improving in quality and therefore increasing in value as a capital asset. Undoubtedly, one of the largest benefits to accrue to the Chinese from this project would be the development of a highly productive, locally adapted, beef "breed", or synthetic,

Table V.I: Base Scenario Technological Improvement Function Values for Component 3 Over Project Lifetime.

		TECHNICAL PARAMETER VALUES				
Year of Project	ADG, bull calves (kg)	Weaning Rate (%)	Conception Rate (%)	Herd Size (head)	Spring Cull Lvwt (kg)	Cow Mortality (%)
2	-	-	65.0	1000	450	5.00
3	.70	80.0	68.3	2000	473	3.75
4	.77	84.0	71.0	3600	491	2.93
5	.83	87.4	73.1	5760	506	2.37
6	.88	89.1	74.6	8640	516	2.01
7	.92	90.0	75.3	10,000	521	1.79
8	.94	90.9	76.1	10,000	527	1.67
9	.96	91.8	76.8	10,000	532	1.60
10	.97	92.7	77.6	10,000	537	1.55
11	.98	93.7	78.4	10,000	543	1.52
12	.99	94.6	79.2	10,000	548	1.51
13	1.00	95.0	80.0	10,000	550	1.50
14	1.00	95.0	80.0	10,000	550	1.50
15	1.00	95.0	80.0	10,000	550	1.50

containing a large proportion of Canadian genetics. The Base Scenario assumes that the joint venture is compensated for the value of the herd in Year 15, at a price equivalent to the price paid for replacement heifers that year.

Herd Management and Nutrition

Intensive management of Component 3 probably provides the greatest opportunity for dramatic improvements in technical coefficents through the use of Canadian expertise, as well as the greatest challenge, considering the current state of cattle management in Heilongjiang. The challenge is particularly great in the realm of animal nutrition, which in Heilongjiang is probably the major obstacle to improving beef cattle performance (Bjorge,1983).

The nutritional regime for the breeding herd in the Base Scenario is primarily pasture-based, with free-choice mineral supplementation. Lack of winter snow cover would permit year round grazing on SFs in the Sanjiang Plain, but the model incorporates nine months of grazing only. This is to allow an improved nutritional regime during late winter, particularly in light of the severe cold and wind chill experienced at that time of year. The basic breeding herd feeding system could be summarized as follows:

May 1 - May 31	Spring pasture (part 1.1)
June 1 - Sep 30	Summer pasture (part 1.2)
Oct 1 - Dec 31	Fall pasture (part 1.1)
Jan 1 - Apr 30	Winter ration

Base Scenario winter ration for cows is 6kg wheat straw and 3.6kg alfalfa silage per head per day, dry matter basis.

Calving would be timed for a short late winter period. Delivery of an even flow of cattle to Component 5 (slaughter) would be achieved by control of ADG of weaned calves in Component 4.

Component 4: Finishing

The primary activity in Component 4 is production of slaughter weight cattle, from weaned calves and cull animals purchased from Component 3. Other products include replacement heifers for Component 3. The term "finishing" does not imply finishing to Canadian standards, and may include a period of slow gain the first winter known as "backgrounding" in Alberta. Emphasis is on heavy use of pasture and silage resources. Proper nutritional management would probably permit all cattle, except breeding herd culls, to be of slaughter weight in less than two years. With bull calves on 90% high-quality silage and 10% corn supplementation, slaughter weight would be attainable at 18 months or younger. Steers and heifers would require more time to achieve slaughter weight.

System 4 has four parts corresponding to four different types of rations. Cost/kg gain, net revenue, and net revenue per head are calculated for each part, allowing comparison of the different feeding strategies. This program, however, does not calculate least cost rations within the separate parts or involve any other forms of optimization.

Cattle performance in the three feedlot parts (4.1, 4.2, and 4.4) is summarized in two coefficients, average daily gain (ADG) and daily feed intake, and for the pasture part (4.3) is summarized by ADG alone. Average daily gain is determined by a TIF specific to each feeding activity (See Table V.2.). Daily ration intake (and, concomitantly, FCRs) for Component 4 are generated using the bioenergetics computer program FMCATTLE (Young,1986), based on input for average animal weight, estimated climatic conditions, ADG (as generated by the TIF), and NAS-NRC data on feedstuff characteristics applied to the assumed ration. State farm resources permit supplementation with a wide variety of feedstuffs, including corn, barley, soybean processing byproducts, and sugar beet tops and pulp.

The other TIFs in Component 4 represent feeder mortalities, with one mortality function for just weaned calves (Parts 4.1 and 4.2) and a second TIF (with lower values) for yearling animals (Parts 4.3 and 4.4). Cattle finishing performance is modeled to start low relative to North American standards. Part 4.1 corresponds to confinement feeding of a "high gain" (but not high concentrate) ration to just-weaned bull and heifer calves, during their first winter. Young heifers are sold to Component 3 as replacement breeding stock the following spring. All bulls entering this component are fed out to slaughter weight on a 90% silage, 10% "supplement" ration. Appendix F lists rations used in the Base Scenario. The supplement in the Base Scenario is assumed to be corn, and the ration is assumed to be balanced with regards to mineral requirements. In the Base Scenario, after Year 10 there is a surplus of in-herd replacement heifers. These are sold at replacement heifer transfer prices by Component 4 to other farms in Heilongjiang, on the assumption that if a pilot project is successful up to Year 10, similar projects or expansions would develop elswhere on the Sanjiang Plain.

Part 4.2 is the "backgrounding" ration, intended to provide medium to low rates of gain for steers destined for summer pasture. The Base Scenario is a 100% silage ration with no supplementation. Average daily gain in subcomponent 4.2 is a constant target value (.6kg/day), to which daily intake is balanced to achieve.

Subcomponent 4.3 represents yearlings and spring culls on spring and summer pasture (Component 1). Respectable gains are anticipated on rotationally grazed pastures. Cattle are to be removed from pasture by September 1, whereupon they are slaughtered if heavy enough,

Table V.2: Base Scenario Technological Improvement Function Values for Component 4 Over Project Lifetime.

	TECHNICAL PARAMETER VALUES			
Year of Project	ADG, weaned bulls (kg)	ADG, steers (kg)	Mortality; 4.1,4.2 (%)	Mortality; 4.3,4.4 (%)
3	0.8	0.7	5.00	2.00
4	0.9	0.8	4.00	1.70
5	1.0	0.8	3.32	1.48
6	1.1	0.9	2.86	1.33
7	1.1	0.9	2.54	1.22
8	1.2	1.0	2.31	1.14
9	1.2	1.0	2.17	1.08
10	1.2	1.0	2.09	1.04
11	1.2	1.0	2.02	1.01
12	1.3	1.0	2.00	1.00
13	1.3	1.1	2.00	1.00
14	1.3	1.1	2.00	1.00
15	1.3	1.1	2.00	1.00

or enter Part 4.4 if not. ADG is the key technical transformation rate in 4.3.

Part 4.4 is the feeding of "long yearlings" from 4.3 on the same silage and supplement ration employed in Part 4.1. Performance levels are lower than for Part 4.1, due to the feeding of steers rather than bulls, and the higher average weight of the cattle fed in 4.4. Improvements in performance levels over those set the the Base Scenario would eliminate the need for Part 4.4 in latter years of the project.

The major input for Component 4 is calves and cull cattle from Component 3, followed by pasture from Component 1 and silage from Component 2. Other inputs are ration supplement, personnel, and veterinary and miscellaneous supplies. Yardage is a per-head per-diem cost assigned to represent feedlot operation and maintenance expenses not included in other expense catagories. Capital requirements for Component 4 are the feedlot and site, plus all attendant machinery and equipment.

Efficient management of Component 4 is critical to providing the benefits of vertical integration to the enterprise. A uniform but seasonal input of weaned calves from Component 3 can be managed in such a way as to result in a steady flow of slaughter cattle throughout the operating season of Component 5. In North America, there is a trend for packers to purchase and operate feedlots in order to benefit from this type of vertical integration.

Component 5: Slaughter/Primary Processing

Component 5 is important because it links the joint venture to the outside world. Component 5 models the slaughter of beef and all the primary processing which can take place on site, such as cutting, deboning, and packaging beef into a readily transportable form (frozen boxed beef), preparing cuts and edible byproducts destined for domestic markets, and minor processing of inedible byproducts (eg. salting hides, grinding bone meal, refining tallow, producing blood meal. Primary processing in the Base Scenario includes the production of packaged dry beef for export markets.

Component 5 has two parts. Part 5.1 models the slaughter process and is further subdivided by class of animal slaughtered, since technological coefficients vary between catagories of animals. The subdivisions of 5.1 are: 5.11 - cow and heifer slaughter, and 5.12 - bull and steer slaughter.

Key technnological transformation rates for both slaughter subdivisions are dressing percentage (carcass less waste and byproducts), finishing percentage (yield of boxed frozen boneless beef), and waste percentage (unusable material plus shrink loss). All of the aforementioned technical efficiencies are expressed as a percentage of animal liveweight. The values of 5.12 transformation rates are derived directly form its TIFs. The values for 5.11 are based on 94% of 5.12 efficiences. Labor use is also derived from a TIF. TIF values for Component 5 are listed in Table V.3.

Component 5 byproducts are subdivided into the following catagories: 1) edible byproducts such as liver, tongue, tripe, etc., for which there appears to be a strong domestic demand, 2) inedible byproducts such as inedible tallow, which can be rendered fit for sale with minor on-site processing, 3) bone meal for use as animal feed, 4) blood meal for feed, and 5) salted hides, for which there exists a strong domestic market. The yield of these byproducts is calculated on the basis of the difference between dressing percentage and waste percentage for each slaughter subcomponent. Edible byproducts represent 26.4% of this

Table V.3: Base Scenario Technological Improvement Function Values for Component 5 Over Project Lifetime.

	TECHNICAL PARAMETER VALUES					
Year of Project	Dressing %, steer	Finishing %, steer	Waste %, steer	Dry Beef Yield(%)	Labor Rqmt, Sltr (mhr/hd)	Labor Rqmt, Proc (mhr/hd)
2	- *	- *	- *	45.00	- *	8.0
3	56.00	46.00	30.00	46.35	4.0	7.2
4	57.68	47.38	28.50	47.28	3.4	6.6
5	58.83	48.33	27.65	47.75	3.0	6.2
6	59.42	48.81	27.09	48.23	2.8	5.8
7	60.02	49.30	26.82	48.71	2.5	5.5
8	60.82	49.79	26.55	49.20	2.4	5.3
9	61.00	50.29	26.29	49.69	2.2	5.1
10	61.00	50.79	26.02	50.00	2.2	5.0
11	61.00	51.00	25.76	50.00	2.0	5.0
12	61.00	51.00	25.51	50.00	2.0	5.0
13	61.00	51.00	25.25	50.00	2.0	5.0
14	61.00	51.00	25.00	50.00	2.0	5.0
15	61.00	51.00	25.00	50.00	2.0	5.0

*No steer slaughter until Year 3 of project.

difference, inedible byproducts 23.3%, bone meal 19.2%, blood meal 3.1%, and hide 28.0 %.

Part 5.2 is the processing part, and in the Base Scenario models the production of specialized dried beef products. The part uses all of the boneless beef produced from cull cow and cull bull slaughter to produce its product. Dried beef yield is a TIF.

There are two basic marketing thrusts for the products of Component 5. The primary thrust is the sale of medium to high-quality, frozen boxed boneless-beef, and packaged dry-beef, in Chinese and Asian foreign currency markets. The export sale of relatively high value product is important for the success of the project, because world prices are higher than Chinese prices, and because it is essential to generate foreign currency throughout the life of the project, as is discussed later in this Chapter. Ten percent of Component 5 gross revenue is allocated to marketing, the majority of which would be spent on developing and supplying foreign currency markets. Domestic marketing costs for the canned meat products of the Jiamusi Food Processing Plant of the HGB are reportedly 1% of gross revenue. The secondary marketing thrust would be to market all byproducts within Heilongjiang. Given the apparently high demand for beef byproducts, particularly edible byproducts and hides, this would be accomplished quite readily.

The most important recurrent input for Component 5 is slaughter cattle from 3 and 4. Others inputs are electricity, personnel (fixed and variable portions), marketing, and "variable inputs", an item designed to account for all operating costs, including equipment repair, packaging material, and product testing, and assumed to require foreign exchange. Capital requirements of Component 5 include a serviced site, a slaughter/processing building, frozen storage building and freezing equipment, ancilliary buildings/facilities, vehicles, reefer rail cars, and slaughter and processing equipment. On-site fabrication, and purchase of appropriate used equipment would greatly reduce total capital requirements of the component.

The scale and type of technology employed in Alberta county abbatoirs appears to be well suited to a state farm operation and is the basis for Component 5. Kill rates of 20 head per day are typical for Alberta abbatoirs, but the facilities can handle considerably higher kill rates with the application of additional labor. Modularity (expandability) can be built easily into the simple and efficient design of this type of plant. Furthermore, on-site fabrication of much of the basic slaughter and handling equipment is possible, leaving only a few of the more sophisticated pieces of equipment to be purchased in North America. The small plants are multiespecie, thus additional revenue could be generated from the custom slaughter of pork or sheep during non-peak periods.

The Base Scenario assumes freezing of all deboned beef and periodic marketing by refrigerator cars. Accordingly, a large freezing facility is included in the capital expenditures of Component 5, based on capital costs of freezer plants in China.

Component 6: Headquarter Functions

Component 6 examines key parameters for the entire integrated enterprise. The model aggregates costs, returns, and capital expenditure information for the complete system to calculate a single, comprehensive IRR, which also takes into account capital and operating expenses borne by the entire system, not accounted for elsewhere in the model (headquarter functions). Such costs include costs for training, project management, administration, promotion, and quality control. The ability of a joint venture to implement a western-style management system, including freedom of hiring and firing, performance bonuses, computerized inventory control, etc., is perceived by Chinese authorities interviewed to be a key advantage of the joint venture format. Component 6 would be responsible for efficiently administering such a management system.

Intercomponent transfer prices and internal capital adjustments (for example, sales of herd inventory to Component 5), are not included in Component 6 calculations, since they have no effect on overall IRR. The procedure for determining intercomponent transfer prices adopted in this model, is to equalize IRR of Components 1 through 5, for any given Component 6 IRR, through the use of transfer price adjustments. For example, an increase in the price of Component 5 outputs would be passed on to all production components, through the increase of transfer prices of intermediary products, until IRRs for the five production components were equated. This is a workable procedure, which may have practical management applications, as discussed in Chapter VII.

Successfully implementing the technical-training component of project management would be critical to final project success. Training, and specific technology transfer costs, are listed as a separate item under Component 6 expenses, and are given a relatively large budget allocation. The technology transfer program is intended to include yearly on-site training programs as well as special trouble-shooting missions by Canadian experts. It is possible that much of the cost of training and technology transfer can be covered by specific government programs (See Appendix D.). Special attention would be necessary for the potential problem area of cattle management and herd development. One proposed strategy is to send Canadian farmers on brief training tours, for the purpose of teaching hands-on management techniques.

Component 7

Component 7 is an aggregation of financial output from the model, relevant to project financial performance and equity structure, and other joint venture considerations.

Unlike the other six components, Component 7 does not have a physical counterpart in the project.

The first section of Component 7 output calculates total personnel requirements, or project employment generation. In the next section, yearly measures of "financial efficiency" are calculated and tabulated. The measures of financial efficiency include total output and net revenue per employee, per area in forage, and per head of breeding cows. The tabulations can be used to compare the potential joint venture with other state farm investments.

The third part of Component 7 addresses foreign currency balance of the project. The joint venture requires foreign currency to:

1. meet obligations for foreign-sourced operating inputs.
2. meet foreign currency goals of Chinese investors.
3. achieve tax benefits and other special state perquisites for the joint venture.
4. pay out foreign partner's profit share.

Component 7 tabulates operating foreign currency balance for all years of the project[26]. Component 7 also calculates ratio of foreign currency sales to total sales, which, under current legislation, must be >=.70 to qualify the joint venture for substantial tax breaks, as noted in Appendix B.

The next part of Component 7 calculates equity share of the foreign partner. The underlying assumption is that the foreign partner's equity contribution will be matched to meet capital cost requirements for all foreign-sourced capital items. Foreign partner equity share is a negotiable issue for a joint venture, but in no case would it be less than foreign capital requirements of the project.

To calculate minimum foreign partner equity share it is necessary to bring back all capital costs for the project to a common (Year 1) basis. This is done by NPV calculation of the capital requirements over project lifetime, based on a 15% discount rate. Minimum equity share is not sensitive to discount rate chosen in the NPV calculations. In practice, probable foreign partner equity share for the project would be the next highest round figure to calculated minimum foreign equity requirement. Probable foreign equity share is also listed in Component 7 output.

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[26] In model hardcopy, capital and operating expenditures requiring foreign exchange are noted in block letters. Similarly, sales which are received in foreign currency are highlighted in block letters.

The final part of Component 7 calculates IRR to the foreign and Chinese partner. This output is relevant only if the foreign partner were to supply actual capital assets to the joint venture, rather than contribute an initial equity investment, and have the joint venture subsequently purchase all capital inputs as an independent unit. In the absence of profit-extraction tax for the foreign partner, as is the case at under current legislation, and with joint venture purchase of all capital inputs, the IRR to the Chinese and foreign partner would be identical.

B. SUMMARY

This chapter has presented in some detail a description of the investment-analysis model employed in the study. It has also attempted to explain the mangement systems rationale for the model. The primary goal of the systems design excercise outlined in this chapter was to design a workable and plausible beef production system for a joint venture on the Three Rivers Plain of Heilongjiang.

The model developed is based on a large amount of information collected in two countries. It is not presumed that the model represents the best possible structure for a joint venture in beef production between Heilongjiang and Alberta. However, it should provide a useful benchmark for analysis of the feasibility decision.

VI. Results

This chapter contains a summary of results obtained from the cash-flow model employed in this study, as well as a discussion of some of the major limitations of this work. The actual results of the work are contained in the first three sections. The first section outlines in general terms the output of the Base Scenario of the model, the second section summarizes sensitivity analyses conducted, and the third portion reports on experiments conducted. A discussion of study limitations comprises the fourth part of this chapter.

A. BASE SCENARIO RESULTS

This section summarizes production and financial output from the Base-Scenario of the investment-analysis model described in Chapters IV and V of this thesis. Actual output from the Base Scenario of the model is contained in Appendix F.

Key Financial Output

Key financial output from the Base Scenario is presented in Table VI.1, and represents the case where transfer prices have been used as a mechanism to equate the IRRs of the five production components. The IRR for the entire JV before tax is 22%, while the individual production components generate IRRs of 31% or 32%.

The project has a total capital requirement of Y8,985,438 (based on a discount rate of 15% for capital investments in Years 2 through 15) or $3,455,938.[27]. The foreign capital requirements of the project consist primarily of specialized machinery and have a NPV of $1,119,530, representing 32% of total capital requirements, which thus becomes the minumum foreign partner equity share in the joint venture. The joint venture, as modeled in the Base Scenario, is an efficient producer of foreign exchange, generating an operating (i.e. exclusive of capital purchases) foreign currency surplus by Year 3, which stabilizes at 75% of total sales for the majority of project lifetime.

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[27] All dollar values based on exchange rate of 2.60 Chinese Yuan/dollar.

Table VI.1: Key Financial Output, Base Scenario.

IRR, System	22%
IRR, Component 1 (grass)	31%
IRR, Component 2 (silage)	31%
IRR, Component 3 (cow/calf)	32%
IRR, Component 4 (finishing)	32%
IRR, Component 5 (sltr/proc)	32%
NPV, Foreign Capital*	Y 2,910,777
NPV, Foreign Capital	$ 1,119,529
Minimum Foreign Partner Equity Share	32%
Probable Foreign Partner Equity Share	35%
Exchange Rate	2.60 Y/$

*All NPV calculations based on 15% discount rate.

If all capital inputs are purchased jointly on behalf of the joint venture, then the IRR before tax for both partners will be equivalent to System IRR, which is the preferred situation. However, System 7 output shows that if the foreign partner must independently supply all foreign exchange capital requirements, and the local partner all Chinese capital requirements then, in the Base Scenario, the venture is more profitable for the Chinese than the Canadian partner. This is due to the influence of timing of capital investments over the 15 year period, which differs for foreign and Chinese capital inputs, as well as the influence of exchange rates (See Experiments section of this chapter.).

While potential investors are interested in the expected rate of return on investment, IRR is not the sole financial criteria which must be examined. In particular, cash-flow characteristics of the investment are also very important. Thus, while this hypothetical joint venture has a reasonably favorable IRR, its cash-flow characteristics would discourage many investors. As can be seen from Figure VI.1, cash-flow for the project is negative for the first five years, after which it is positive and increasing. This is related to substantial start-up costs and the costs of developing a large cattle herd over a relatively short period of time. Payback on original capital outlay would not occur until Year 8.

Figure VI.1: Base Scenario Project Cash Flow Characteristics.

Production Components

The following section describes some production and financial characteristics of Base Scenario output, component by component.

Component 1

Subsystem 1.1 (intensively managed tame pasture) supplies forage totalling 41,000 AUMs by Year 7 of the joint venture, on an area of 3133 ha for an animal intensity of 13.1 AUM/ha, or 1.1 animals per hectare per year. This carrying capacity is achieved on a yield of 8412 kg/ha dry matter and 70% utilization. Increases in yields in subsequent years are superfluous to basic requirements of the venture. Subsystem 1.2 (summer pasture) has a more variable stocking rate, owing to differing summer feed requirements for different years in System 4. All system requirements for summer forage to a maximum of 46,757 AUM in Year 15 are met on 6493 ha of semi-improved grassland, resulting in a peak animal intensity of 7.2 AUM/ha on less than 50% utilization of a 8000 kg/ha yield.

With grazing fees of 16.50 Y/AUM, Subsystem 1.1 achieves a maximum net revenue of 203 Y/ha by Year 7, Subsystem 1.2 a maximum of 106 Y/ha by Year 12, and Component 1 as a whole 138 Y/ha by Year 14. Machinery operation is the largest single operating expense, while new area development and forage establishment is the largest capital expense (200 Y/ha for Subsystem 1.1 and 150 Y/ha for Subsystem 1.2.).

Component 2

The land seeded to alfalfa for silage achieves a maximum DMY of 9604 kg/ha in Year 15, given 50 kg/ha P_2O_5 application. This is accomplished on 1976 ha of cropland and results in total silage production of 17,834 tonnes after waste. By Year 15, a total of 5436 ha of cropland has been returned to state farm grain production after a five year period under alfalfa, including establishment year, which potentially represents a substantial contribution to soil improvement on the state farms involved. Maximum silage crude protein level of 18% is achieved in Year 11.

Component 2 net revenue increases throughout project lifetime to a maximum of 723 Y/ha in Year 15. This is based on silage prices of 140 Y/tonne and 160 Y/tonne for medium and high quality silage respectively. Land rental at 450 Y/ha is by far the largest operating expense, followed by machinery operation.

Component 3

The system attains target herd size of 10,000 head in Year 7. This rate of expansion necessitates the purchase of 12,904 fattened dairy heifers from Component 4 from Years 1 through 9, in addition to in-herd replacement heifers. Component 3 is the most labor intensive in the project, employing 217 laborers, 58 technicians, and 7 managers by Year 15. The logistics of management of Component 3 are formidable and suggest that contracting to family farmers may be more realistic than a project-managed herd.

With prices for weaned bull calves, steer calves, and heifer calves of 4.35 Y, 4.15 Y, and 3.95 Y per kg respectively, the cow/calf component generates a total revenue of 604 Y/hd and a net revenue of 150 Y/hd by Year 15. The largest operating expenditure is winter rations, representing 32% of total operating costs in Year 15. Pasture represents 30% of total operating costs and semen/AI supplies at 70 Y/hd account for 15% of operating expenses in Year 15. It is possible the joint venture could save on the substantial operating cost of wheat straw purchase (73.80 Y/hd in Year 15) by harvesting native hay in June.

The relatively low net revenue per head of Component 3 is compensated for by sale of cull animals (capital assets) to Component 5, resuting in a more favorable cash-flow than would otherwise be the case. Sales of cull cows represent the largest source of cash inflow into the cow/calf component.

Component 4

Component 4 (finishing) is one of the least stable components in terms of financial performance, being very sensitive to transfer pricing changes. Output is complicated by the fact that the component engages in three type of activities:

1. fattening bull calves and steer calves to slaughter weight.
2. fattening dairy heifers purchased outside the JV to breeding weight.
3. fattening in-herd replacement heifers to breeding weight.

Each activity has its own production and financial characteristics. Due to lower average body weight and concomitantly lower feed conversion ratios (FCRs), feeding of heifers is the most profitable activity in Component 4. Consequently, there is an aberration in Year 5 in financial and physical output of the model, when off-farm dairy heifer purchases peak at 3462 head. Subsystem 4.1, which includes heifer-fattening activities, actually achieves peak net revenue in Year 5, and generates negative (although improving) net revenues in Year 7 through 15.

Not surprisingly, silage represents the largest operating expense in Component 4 after cattle purchase.

Component 5

For cull cow slaughter (Subsystem 5.11), slaughter numbers peak at 3468 head in Year 7 and stabilize to 3000 head by Year 14, achieving an average liveweight of 587 kg by Year 15. Subsystem 5.12 (bull and steer slaughter) increases to a maximum of 3692 head in Year 15. Total Component 5 slaughter is thus 6692 head in Year 15 or 22 hd/day, which is well within the capabilities of a typical Alberta country abbatoir (based on 304 days of operation).

In Year 15, the slaughter/processing facility produces 914 tonnes of frozen boxed beef, and a further 505 tonnes of dried beef products from cull cow and cull bull meat, generating foreign exchange revenue equivalent to Y12,428,339. The remaining 26% of Component 5 revenue is generated through the sale of hides and edible and inedible byproducts domestically.

Component 5 financial performance, like Component 4, is price sensitive and more profitable in the earlier stages of the project. This is due to the greater relative profitability of slaughtering culls and processing the meat, compared to slaughtering steers and young bulls and selling frozen boxed-beef. This economic performance is based on boxed-beef price of $1.92/kg, which equates at Base Scenario exchange rates to 5.00 Y/kg, and a dried, packaged-beef price of $5.77/kg, which equates to 15.00 Y/kg. After cattle purchase costs, marketing, at 10% of gross revenue, is the largest operating expense of Component 5, followed by variable inputs, a catch-all for packaging and processing materials which must be imported. At labor productivities several times lower than for comparable operations in Alberta, labor is still a minor production cost, which helps the competitiveness of this component.

Components 6 and 7

The training and technology transfer program represents the largest operating cost for Component 6, followed by salaries of permanent Canadian staff. Combined operating and capital costs for Component 6 reduce project IRR from 32% to 22%.

Under the Base Scenario, the joint venture employs 279 laborers, 71 technicians, and 16 Chinese managers in Year 15. Table VI.2 lists total output and net revenue per employee, area under forage (mu or ha), and per head of breeding cows for Year 15 of the Project, in comparison to similar statistics for selected cropping and business ventures in Heilongjiang. It can be seen that the enterprise compares favorably in terms of these measures with other types of investments in the General Bureau system.

B. SENSITIVITY ANALYSIS

The following section contains a summary of results of a series of sensitivity analyses conducted using the Base Scenario of the investment-analysis model employed in this study. The objectives of the sensitivity analysis were threefold:

1. to determine and highlight model weaknesses; for example, high sensitivity to parameters which are very uncertain.
2. to compare model response to parameter changes to expected results, thus generally assessing the model's logical validity.
3. to allow generalizations based on the analysis; for example, to state which parameters are most critical to project success.

The general procedure of the sensitivity analysis was to adjust given parameters in a systematic, stepwise fashion and note the effect on IRRs for individual components and the project as a whole. The parameters adjusted included technological parameters and financial parameters. The former could be considered to be influenced by both the environment and intra-system relationships, while the latter are purely environmental factors acting on the system. Specific procedures for the various tests are described in greater detail later in this section, along with result summaries. The section begins with a summary of results of the

Table VI.2: A Comparison of Measures of Financial Efficiency: Base Scenario vs State Enterprises, Chinese Yuan, 1986.

Measure	Base Scenario, Year 5	Base Scenario, Year 15	Wheat on SF 852	Jiamusi Food Proc Fact	Harbin Shoe Factory
Total Output/Employee	32,693	47,198		14,000	33,529[1]
Total Output/Mu*	59	583	79.0		
Total Output/Ha*	882	8746	1184		
Total Output/Head**	1385	1728			
Net Revenue/Employee	3691	24,386		n.a.	n.a.
Net Revenue/Mu*	7	51	25.23		
Net Revenue/Ha*	100	769	378		
Net Revenue/Head**	156	893			

[1] based on average shoe price of 30Y/pair.

*based on area in silage, pasture or crop. For JV includes fee of 450Y/ha for rent of SF cropland.

**based on number of cows in breeding herd.

Sources:

1. Base Scenario Results.
2. SF 852 Records.
3. Interviews with factory managers.

sensitivity analysis performed.

The following definitions apply to results reported in this section:

1. "Critical IRR" is the rate of return below which the investment would probably not be undertaken and is assumed to be 20% in this analysis.
2. The comment "component IRR jeopardized" indicates that, under the conditions of that particular run, critical IRR is not achieved.
3. A "disproportionate response" means that IRR for that component changes more (on a percentage basis) than the the amount by which the parameters being tested were changed.
4. An IRR which exhibits a "disproportionate response" to parameter changes is deemed to be sensitive to that parameter. An IRR which exhibits a less than proportionate response is deemed to be insensitive to that parameter.
5. "Critical levels" are levels of technology at or below which project IRR may be jeopardized.

Summary of Sensitivity Analyses

The following points summarize results of the sensitivity analysis reported in this section. With respect to System IRR:

1. Financial parameters are more important than technological parameters.
2. Output prices are the most critical financial parameters, followed by input prices, exchange rate, and capital costs.
3. Greater responsiveness exists to decreases in capital costs and to decreases in the Y/$ exchange rate than to increases.
4. Salary levels of Chinese employees have very little effect.
5. Lower limit assumptions of TIFs are more important than upper limit and technological improvement assumptions.
6. Greater sensitivity exists to decreases in technical efficiency than to increases.
7. Component 5 technological efficiency is the most important; Component 1 the least.
8. Component 2 technological efficiency is the second most important.

More generally:

1. There is considerable interaction between the components of the model, particularly Components 3, 4, and 5, making it impossible to isolate the effects of any technological or financial change to only one system.
2. Components 4 and 5 are the least stable and Components 1 and 2 the most stable in terms of financial performance as independent units.
3. Technological improvement is important for Component 5 and for the project as a whole, but less important for the first four production systems.
4. On the whole, the model produces plausible results with respect to the effect of tested changes in financial and technological parameters.

Sensitivity to Changes in Technological Parameters

Sensitivity to changes in technological parameters was tested in three stages, in order to independently test the three types of assumptions which pertain to the model's TIFs. The first catagory of assumptions are starting values for TIFS, thus the first part of this analysis tests output sensitivity to changes in starting values.

The second type of technological assumption is for limit levels of TIFs, representing peak production or efficiency levels attained after 10 years or more of production. In the second stage of this analysis, sensitivity to TIF limit values is tested.

Finally, sensitivity to the assumption of technological improvement over project lifetime was tested by observing the effect of setting technological improvement for selected coefficients to zero.

Lower Limit Technical Efficiency

Components 1 and 2

The starting values for four TIFs important to grass and silage production were adjusted concurrently at 10% intervals and effect on Component and Project IRR recorded. The four TIFs tested were DMY Subsystem 1.1 (spring/fall pasture), DMY Subsystem 1.2 (summer pasture), DMY Component 2 (alfalfa production), and silage waste. Results of this analysis are noted in Table VI.3.

The results show that System IRR is not sensitive to starting levels of Component 1 and 2 TIFs. At 70% or lower of base level production (and at or above 130% of base level wastage) the project may be jeopardized. Corresponding critical levels for starting values of Component 1 and 2 technology are shown in Table VI.4.

Component 2 IRR is sensitive to technical efficiency while Component 1 is not. This is logical considering the relative costs of land to the two components. IRRs of Components 1, 2, and 6 (system) all exhibit greater sensitivity to decreases in starting levels of Component 1 and 2 TIFs than to increases.

Component 3

Starting values of six TIFs related to efficiency of the breeding herd were adjusted concurrently at 5% intervals, and their impact on IRR of Component 3 and the project as a whole noted. The six TIFs adjusted were: birthweight, average daily

Table VI.3: Components 1 and 2 Upper and Lower Limit Sensitivity Analyses.

Technical Efficiency (%)	Lower Limit			Upper Limit		
	IRR1 (%)	IRR2 (%)	IRR6 (%)	IRR1 (%)	IRR2 (%)	IRR6 (%)
150	37	55	24	31	31	22
140	37	52*	24	31	31	22
130	36	48*	24	31	31	22
120	35	43*	23	31	31	22
110	33	38*	23	31	31	22
BASE LEVEL	31	31	22	31	31	22
90	29*	24*	21	31	31	22
80	26	15*†	20	31	30	22
70	23	04*†	19†	29	27	22
60	21	-11*†	17†	27	18*†	21
50	16*†	-66*†	14*†	23	-15*†	19*†

*Rate of return demonstrates disproportionate response to changes in efficiency.
†Component IRR jeopardized.

Table VI.4: Lower and Upper Critical Levels for Component 1 and 2 Technology.

TIF	Units	Lower	Upper
DMY, tame pasture	kg/ha	3500	5000
DMY, improved range	kg/ha	2100	4000
DMY, alfalfa	kg/ha	3500	5000
Silage Waste	%	15.60	9.0

Note: See text for definition of critical levels.

gain, conception rate, weaning rate (birth rate held constant at 95% through all tests), cow mortality, and cull cow liveweight. Results of the analysis are presented in Table VI.5, and levels of technical coefficients corresponding to the various runs are presented in Table VI.6.

System IRR is not sensitive to Component 3 TIF starting values; critical levels of starting technological efficiency are very low at 75% of Base Scenario values. Component 3 IRR is sensitive to decreases in TIF starting values but insensitive to increases in TIF starting values.

Component 4

In this analysis, starting values for TIFs pertaining to cattle growing and finishing (Component 4) were adjusted at 5% intervals, over a ±25% range, and the

Table VI.5: Component 3 Upper and Lower Limit Sensitivity Analyses.

Technical Efficiency (%)	Lower Limit IRR3 (%)	Lower Limit IRR6 (%)	Upper Limit IRR3 (%)	Upper Limit IRR6 (%)
120	37	22	32	22
115	37	22	32	22
110	36	22	32	22
105	34	22	32	22
BASE LEVEL	32	22	32	22
95	26*	22	31	22
90	21*	21	26	22
85	14*†	20	20	21
80	6*†	20	#	#
75	-3*†	18†	#	#

*Rate of return demonstrates disproportionate response to changes in efficiency.
†Component IRR jeopardized.
#Equivalent to zero technical improvement assumption at or below this level of technical efficiency.

Table VI.6: Starting and Limit Values for Component 3 TIFs During Sensitivity Analysis.

TIF Combined Efficiency Level (%)	Birthweight, bull calves (kg)		ADG, bull calves (kg)		Weaning Rate (%)		Cow Mortality (%)		Cull Cow Lvwt (%)		Conception Rate (%)	
	Start	Limit	Start	Limit	Start	Limit	Start	Limit	Start	Limit	Start	Limit
115	40.3	51.8	0.8	1.2	92.0	95.0	4.3	1.3	51.8	55.0	74.8	92.0
110	38.5	49.5	0.8	1.1	88.0	95.0	4.5	1.4	49.5	55.0	71.5	88.0
105	36.8	47.3	0.7	1.0	84.0	95.0	4.8	1.4	47.3	55.0	68.3	84.0
BASE LEVEL	35.0	45.0	0.7	1.0	80.0	95.0	5.0	1.5	45.0	55.0	65.0	80.0
95	33.3	42.8	0.7	1.0	76.0	90.3	5.3	1.6	42.8	52.3	61.8	76.0
90	31.5	40.5	0.6	0.9	72.0	85.5	5.5	1.7	40.5	49.5	58.5	72.0
85	29.8	38.3	0.6	0.9	68.0	80.8	5.8	1.7	38.3	46.8	55.3	68.0
80	28.0	36.0	0.6	0.8	64.0	76.0	6.0	1.8	36.0	44.0	52.0	64.0
75	26.5	33.8	0.5	0.8	60.0	71.3	6.3	1.9	33.8	41.3	48.8	60.0
70	24.5	31.5	0.5	0.7	56.0	66.5	6.5	2.0	31.5	38.5	45.5	56.0
65	22.8	29.3	0.5	0.7	52.0	61.8	6.8	2.0	29.3	35.8	42.3	52.0

effect on key financial output recorded. The TIFs which were concurrently adjusted include ADG for Subsystems 4.1 (intensive feeding), 4.3 (steers on pasture), 4.4 (finishing of steers from pasture); and mortality rates for two classes of animals, weaned calves and yearlings.

As can be seen in Table VI.7, System IRR is not sensitive to starting values for Component 4 TIFs, and does not respond to increases in starting level technology in Component 4. Component 4 IRR, however, is very sensitive to starting values of TIFs and reaches a critical level at 90% of baseline technical efficiency.

Component 5 Combined Technical Efficiency Testing

The effect of changes in starting and limit values of TIFs in Component 5 (slaughter/processing) on Component and System IRR was tested. With the exception of labor use, the TIFs of Component 5 represent a special case in that a very narrow range of improvement is likely to occur over the lifetime of the project. Therefore, sensitivity analysis was conducted at 5% intervals and only one value (starting or limit) was altered for each of the six TIFs. Thus, for decreases in efficiencies, limit levels were reduced by 5% while starting values were held constant, and for improvements in technical efficiencies, limit values were held constant, while starting values were adjusted (See Table VI.9.). In addition, the total testing range was only ±10%. TIFs tested in this analysis were dressing %, finishing %, waste and shrink, dry beef yield, and labor requirements for slaughter and processing subsystems. Table VI.10 presents a summary of this analysis and Table VI.9 the levels of technical efficiencies associatied with test levels.

Results indicate that Component 5 IRR is very sensitive to technological efficiency and is particularly responsive to decreases in technical efficiencies. Slaughter and processing efficiencies only 5% below base levels result in negative cash flows in all years for Component 5, and thus IRRs which cannot be calculated.

System IRR responds to changes in Component 5 technology but is not sensitive except when upper limit technical efficiencies drop from 95 to 90%, in which case the project may be jeopardized.

Table VI.7: Component 4 Upper and Lower Limit Sensitivity Analyses.

Technical Efficiency (%)	Lower Limit IRR4 (%)	IRR6 (%)	Upper Limit IRR4 (%)	IRR6 (%)
125	56	22	32	22
120	53	22	32	22
115	50*	22	32	22
110	45*	22	32	22
105	39*	22	32	22
BASE LEVEL	32	22	32	22
95	22*	22	31	22
90	6*†	22	29	22
85	-54*†	21	24	22
80	#†	21	#†	22
75	#†	21	#†	22

*Rate of return demonstrates disproportionate response to changes in efficiency.
†Component IRR jeopardized.
#Rate of return cannot be calculated due to cash flow characteristics.

Table VI.8: Starting and Limit Values for Component 4 TIFs During Sensitivity Analysis.

TIF Combined Efficiency Level (%)	ADG, weaned bull (kg)		ADG, steer (kg)		Mortality: 4.1.4.2 (%)		Mortality: 4.3.4.4 (%)	
	Start	Limit	Start	Limit	Start	Limit	Start	Limit
125	1.0	1.6	0.9	1.4	3.75	**1.5**	1.5	0.75
120	1.0	1.6	0.8	1.3	4.00	**1.6**	1.6	0.80
115	0.9	1.5	0.8	1.3	4.25	**1.7**	1.7	0.85
110	0.9	1.4	0.8	1.2	4.50	**1.8**	1.8	0.90
105	0.8	1.4	0.7	1.2	4.75	**1.9**	1.9	0.95
BASE LEVEL	0.8	1.3	0.7	1.1	5.00	**2.0**	2.0	1.00
95	0.8	1.2	0.7	1.0	5.25	**2.1**	2.1	1.05
90	0.7	1.2	0.6	1.0	5.50	**2.2**	2.2	1.10
85	0.7	1.0	0.6	0.9	5.75	**2.3**	2.3	1.15
80	0.6	1.0	0.6	0.9	6.00	**2.4**	2.4	2.20
75	0.6	1.0	0.5	0.8	6.25	**2.5**	2.5	1.25

Table VI.9: Starting and Limit Values for Component 5 TIFs During Sensitivity Analysis.

TIF ~~Combined~~ Efficiency Level (%)	Steer Dressing (%)		Finishing (%)		Waste & Shrink (%)		Dry Beef Yield (%)		Labor Rqmt Sltr (mhr/hd)		Labor Rqmt Proc (mhr/hd)	
	Start	Limit	Start	Limit	Start	Limit	Start	Limit	Start	Limit	Start	Limit
110	61.0	61.0	50.6	51.0	27.0	25.0	49.5	50.0	3.6	2.0	7.2	5.0
105	58.8	61.0	48.3	51.0	28.5	25.0	47.3	50.0	3.8	2.0	7.6	5.0
BASE LEVEL	56.0	61.0	46.0	51.0	30.0	25.0	45.0	50.0	4.0	2.0	8.0	5.0
95	56.0	58.0	46.0	48.5	30.0	26.3	45.0	47.5	4.0	2.2	8.0	5.5
90	56.0	56.0	46.0	46.0	30.0	27.5	45.0	45.0	8.0	5.5	8.0	6.0

Table VI.10: Component 5 Combined[1] Sensitivity Analysis.

Start or Limit Tech Efficiency (%)	IRR5 (%)	IRR6 (%)
110	48*	24
105	45*	23
BASE LEVEL	32	22
95	#†	20
90	#†	17*†

Notes:
[1]See text for explanation of methodology.
*Rate of return demonstrates disproportionate response to changes in efficiency.
†Component IRR jeopardized.

Upper Limit Technical Efficiency

The following section reports results of sensitivity testing of limit values of TIFs for Components 1 through 4.

Components 1 and 2

Increases in limit values of Component 1 and 2 TIFs had no effect on Component or System IRRs (See Table VI.3.), due to the fact that improvement rates are too low to achive the higher efficiency levels. Component 1 IRR is not sensitive to decreases in limit values, but Component 2 IRR is sensitive to decreases below the 70% level. System IRR is jeopardized by a 50% reduction in upper limits of the two forage components, but is otherwise insensitive to limit values of TIFs in those two components.

Component 3

Similar to the case for Components 1 and 2, there is no IRR response to increases in limit values of Component 3 TIFs (See Table VI.5.). There is only slight response of IRRs to decreases in Component 3 TIF limit values and critical values are not attained.

Component 4

. System IRR does not respond to changes in limit values of Component 4 TIFs (See Table VI.7.). Component 4 IRR is sensitive to reductions in limit values of its TIFs below 90% of base levels.

Sensitivity to Technological Improvement Assumption

The second phase of sensitivity testing with respect to technological coefficients involved testing the impact of technological improvement over the life of the project. The reader will recall that, in the Base Scenario, TIFs start at a level approximating current Chinese technology and improve at a rate that allows attainment of current (i.e. 1987) "typical" Alberta levels of technology in the final two or three years of the project. It is important to test the sensitivity of key financial output for the project to this assumption of improvement in levels of performance with time. Sensitivity to the technological improvement assumption is tested by relaxing the assumption of technological improvement, component-by-component, and globally, and noting the effect on key financial output. Specific procedures and results are outlined in the following section.

Components 1 and 2

Technological improvement rates for project lifetime for Component 1 and 2 TIFs, excluding silage crude protein content, were set equal to zero and the effect on financial output noted. The effect of zero technological improvement in Components 1 and 2 can be summarized as follows:

- System IRR decreases to just below critical IRR (to 19%).
- Component 1 IRR also decreases to 19%.
- Component 2 IRR decreases to 5%.

The effect of zero technological improvement in Component 1 (grass) alone is a slight decline in System IRR to 21%. The effect of zero technological improvement in Component 2 (silage) alone is a slight decline in System IRR to 20%. Thus, lack of technological improvement in either Component 1 or 2 alone does not jeopardize the project. Component 2 is more sensitive to the technological improvement assumption than Component 1.

Components 3 and 4

The effect of relaxing the technical coefficient improvement assumption on rates of return was tested in the same fashion for Components 3 (cow/calf) and 4 (finishing), independently, and for both components in conjunction. The results are:

- Zero technological improvement in Component 3 alone reduces **System** IRR slightly to 20%.
- Zero technological improvement in Component 3 alone reduces **Component 3** IRR to 12%.
- Zero technological improvement in Component 4 alone reduces **System** IRR slightly to 21%.
- Zero technological improvement in Component 4 alone results in a net cash-flow

which does not allow determination of its IRR.

- No technological improvement in Components 3 and 4 concurrently reduces System IRR to just below critical level at 19%.

A further observation is that Components 3 and 4 interact biologically and financially in the model; Component 4 IRR improves under zero technological improvement in Component 3. The interaction is due to the fact that poor performance in Component 3 necessitates the feeding of more dairy heifers in Component 4 for sale to Component 3 as replacement heifers and, as already noted, the feeding of replacement heifers is one of the most profitable activities of Component 4.

Component 5

Similarly, the technological improvement assumption was tested for Component 5 (slaughter/processing), with the following results:

- Component 5 profitability declined to the point where IRR could not be determined.
- System IRR declined below the critical level to 15%.

Because of the relatively large impact of Component 5 efficiency on project IRR, the effect of zero technological improvement for specific TIFs of Component 5 was noted:

- Zero technological improvement in dressing and finishing percentages, concurrently, reduces Component 6 (System) IRR below the critical level to 16%.
- Zero technological improvement in waste percentage *or* in dry beef yield reduced Component 6 IRR slightly to 21% in each case.
- Lack of improvement in labor use efficiency, as measured by workers/head slaughtered or processed, has no effect on Component 5 or System IRR.

All Production Systems

The effect of no technological improvement for all TIFs in the model concurrently was determined in this stage of the analysis. This represents an extreme case where none of the components are successful in implementing western technology, and generates the following results:

- System IRR declines well below the critical level to 8%.
- Component 1 IRR decreases to 19%.
- Component 2 IRR decreases to 7%.
- Component 3 IRR decreases to 16%.
- Component 4 IRR increases to 34%.
- Component 5 IRR cannot be calculated.

Sensitivity to Changes in Financial Parameters

In the following section, results of sensitivity testing of key financial output of the model to changes in financial parameters was tested. This includes changes in five catagories of financial parameters, namely: output price, salaries, variable input prices, System 6 operating expenses, and out-of-system capital costs.

Changes in Output Prices

Prices of all output of Component 5, including boxed-beef, dry-beef, edible byproducts, inedible byproducts, blood meal, hides, and bone meal were concurrently adjusted at 10% intervals to a total range of ±50% from levels set under Scenario A. The results of the analysis are presented in Table VI.11.

The only key output affected by these changes is IRR for Components 5 and 6. In the absence of transfer price adjustments between Component 5 and other systems, Component 5 IRR is very sensitive to output price levels, exhibiting a 235% increase in IRR for a 50% increase in output prices from base level. At prices lower than base level, Component 5 yields a indeterminate IRR.

System IRR is sensitive to output prices, although sensitivity to price changes is much less for the project as a whole than for Component 5. System IRR appears to be slightly more sensitive to downward movements of output prices than upward movements, and drops below critical IRR when output prices drop 10% from baseline levels.

Table VI.11: Input and Output Price Sensitivity Analysis.

Combined Prices (%)	Output Prices IRR5 (%)	IRR6 (%)	Input Prices[1] IRR6 (%)
150	104*	37*	7*†
140	94*	34	10*†
130	82*	32*	13*†
120	69*	29*	16*†
110	53*	25*	19*†
BASE LEVEL	32	22	22
90	#*†	18*†	25*
80	#†	14*†	28*
70	#†	10*†	31*
60	#†	5*†	34*
50	#†	0*†	38*

Notes:
[1] includes marketing expense.
*Rate of return demonstrates disproportionate response to changes in efficiency.
†Component IRR jeopardized.
#Rate of return cannot be calculated due to cash flow characteristics.

Upper limit (150%) boxed beef price in this analysis is $2.85/kg, equivalent to 7.50Y/kg at baseline exchange rate, while lower limit (50%) boxed beef price is $.95/kg, equivalent to 2.50Y/kg. The aforementioned prices are considerably below rationed beef prices in China in 1986. Heilongjiang free market beef prices of November, 1986, correspond most closely to the 80% base price run, and yield a System IRR of 14%. Therefore, the enterprise appears potentially profitable at domestic beef prices, although a higher rate of return would be necessary to elicit the substantial investment required.

Changes in Salaries

The impact on key financial output of change in salaries for Chinese labor, technicians, and management was tested. Salaries for the three classes of employees were adjusted at 10% intervals to a total range of ±50% from Base Scenario wage levels. Base Scenario salaries are: labor - 140 Y/month, technicians - 170 Y/month, and management 200 Y/month, all of which are higher than 1986 salaries in rural Heilongjiang. Results of the analysis are summarized in Table VI.12.

Table VI.12: Salary Level Sensitivity Analysis.

Combined Salary Levels (%)	IRR1 (%)	IRR2 (%)	IRR3 (%)	IRR4 (%)	IRR5 (%)	IRR6 (%)
150	30	31	29	30	30	21
140	30	31	30	31	31	21
130	31	31	30	31	31	21
120	31	31	31	31	31	22
110	31	31	31	31	31	22
BASE LEVEL	31	31	32	32	32	22
90	31	32	32	32	32	22
80	31	32	33	32	32	22
70	32	32	33	33	33	22
60	32	32	33	33	33	23
50	32	32	34	33	33	23

Both individual production components, and the project as a whole, are insensitive to changes in employee salaries, typically showing a ±5% change in IRR for a ±50% change in salaries. Component 3 (cow/calf) is the most sensitive to changes in labor prices, exhibiting a ±6% response, while Component 2 (silage) is the least responsive to salary changes, with a change of approximately ±2.5% in component IRR. The low responsiveness of System IRR to salaries in not surprising, given the low price of manpower in China. These results have implications for project design, technology transfer, and factor substitution decisions within a joint venture, as noted in the next chapter.

Changes in Prices of Variable Inputs

Sensitivity analysis for marketing expense of Component 5 and prices of all variable inputs, including labor, was performed; results are presented in Table VI.11. The analysis was restricted to impact of variable input prices on Component 6 IRR.

The results indicate that System IRR is sensitive to input prices but slightly less sensitive to input prices than to output prices. Critical IRR is passed when combined input prices increase 10%, and in all cases there is a disproportionate response to changes in input prices.

Changes in Component 6 Operating Expenses

The impact of changes in operating expenses borne by the project as a whole on project IRR was tested. These include the following items: training and technology transfer program, Canadian staff, Canada office, state farm office and administration, Component 6 management and labor, travel and miscellaneous, and promotional and setup. The results of this analysis are reported in Table VI.13.

System IRR is not sensitive to increases and decreases in Component 6 operating expenses, and increases and decreases affect IRR equally.

Changes in Out-of-System Capital Costs

The effect of changes in total capital costs, exclusive of breeding-herd capital costs, on System IRR was tested; the analysis is summarized in Table VI.13.

System IRR is not sensitive to capital costs. However, critical IRR is passed when capital costs increase to 130% of costs budgeted under the Base Scenario. There is greater response to decreases in capital costs than to increases.

Changes in Exchange Rate

Exchange rate affects model financial output through return from exported products and cost of imported capital goods. In both cases, System IRR benefits from a decline in the value of the Chinese Yuan vis-a-vis the Canadian dollar, as shown in the results presented in Table VI.14. System IRR is sensitive to increases in value of the Chinese Yuan and passes critical IRR when the exchange rate (expressed as Y/$) drops 10%, to a level of 2.34Y/$. System IRR is less responsive to decreases in value of the Yuan, but exchange rate is nonetheless an important parameter affecting project success (See Experiments section of this chapter.).

Table VI.13: Component 6 Operating Expense and Capital Cost Sensitivity Analyses.

Comp 6 Op Exp or total Capital Costs (%)	Comp 6 Op Exp Analysis IRR6 (%)	Capital Cost Analysis IRR6 (%)
150	19†	18†
140	20	18†
130	20	19†
120	21	20
110	21	21
BASE LEVEL	22	22
90	23	23
80	23	24
70	24	26
60	25	27
50	25	29

†Component IRR jeopardized.

Table VI.14: Exchange Rate Sensitivity Analyses.

Exchange Rate, Y/$ (%)	Exchange Rate (%)	IRR6 (%)
150	3.90	34
140	3.64	32
130	3.38	29
120	3.12	27
110	2.86	25
BASE LEVEL	2.60	22
90	2.34	19†
80	2.08	16†
70	1.82	13†

†Component IRR jeopardized.

C. EXPERIMENTS

A number of experiments were conducted, consisting of various modifications of Base Scenario assumptions. The purpose of these experiments was to determine the probable effect of changes in system design, and changes in selected environmental parameters, from baseline assumptions. The experiments have been subdivided into three sections: experiments relating to system structure, experiments relating to technical management of the project, and experiments related to Component 7 (joint venture considerations). Thus the first two sets of experiments deal with changes in intersystem assumptions, while the final set of experiments addresses changes in assumptions regarding system environment.

Project Structure Experiments

Continuous Expansion

It is anticipated that if the joint venture under study were to prove successful in its first few years, there would be considerable interest on the part of the HGB to expand the cattle-producing components of the project to neighboring farms in the same sub-bureau. Therefore, an attempt was made to determine the outcome of this continuous expansion strategy on financial performance of a 15-year joint venture. The experiment and results can be summarized as follows:

Major Assumptions

1. Starting herd size unchanged at 1000 head; maximum herd size trebled to 30,000 head.
2. Maximum herd size attained by Year 15, not Year 7 (continuous expansion).
3. Operating expenses increase to accommodate herd size; capital expenses doubled(due to capital economies of scale in feeding and slaughter/processing systems). No spatial diseconomies.
4. No other changes in basic assumptions.

Summary of Results

1. System IRR decreases from 22% to 21%.
2. Effect on area under forage production by Year 15:
    a. Intensive pasture area (Subsystem 1.1) increases from 3133 to 7907 ha.
    b. Semi-improved pasture area (Subsystem 1.2) increases from 6493 to 15,698 ha.
    c. Area under alfalfa increases from 1976 to 5742 ha.
    d. Total area under alfalfa and subsequently returned to cropland increases from 5436 to 8612 ha.
3. Herd Growth Pattern: Year 7 - 10,483; Year 10 - 19,625; Year 13 - 26,120.

4. Maximum dairy heifer requirement, Year 7 - 3666 head (Base Scenario Year 7 requirement: 3462).
5. Total dairy heifer requirement over project lifetime increases from 13,320 to 30,415 head.
6. Year 15 total slaughter increases from 6692 hd to 19,622 head, or 65 hd/day (based on a 304 day work year).
7. Effect of capital costs on the profitability of expansion:
    a. If capital costs increase directly in proportion to herd size increase (no economies of scale) System IRR drops to 17%.
    b. Capital cost of 1.5 times Base Scenario capital costs, results in System IRR of 25%.

To summarize, the trebling of project size through phased expansion is within the resource capabilities of any given sub-bureau in the Sanjiang Plain in terms of yearly dairy heifer and pasture land requirements. With no capital economies of scale, the expanded project yields an IRR below the 20% critical level. With capital costs doubling, the project yields approximately the same rate of return as under the Base Scenario. Under this experiment the herd is continually expanding and is never in the mature profit-taking phase, therefore the continuous expansion would be unlikely to occur without some agreement for extension of joint venture life. In practice, the decision to extend project life and continue expansion would be based on relative success of the first 4 years of the initial project.

Joint Venture Extension

The preceding discussion highlights the potential importance of project extension as a subject for experimentation. Unfortunately, micro-computing system capabilities (640k) limit testing to a three year extension, for an extended project lifetime of 18 years[21]. The experiment conducted in this section consisted of extending project lifetime by 3 years with no other changes in baseline assumptions. This procedure was applied first to the Base Scenario, and secondly to the 1.5 times capital cost, continuous-expansion Scenario reported in the previous section. For the Base Scenario, System IRR increases slightly from 22% to 23%, and for the latter scenario there is also a slight increase from 25% to 26%. The results suggest that extending project duration may enhance return on investment slightly. However, it is not practical to consider project lifetimes beyond 20 years, owing to large capital replacements which would be necessitated[29].

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[21] Difficulty of expansion is one of the key limitations of the spreadsheet modeling approach, as compared to recursive models.

Technical Management Experiments

The results of a series of experiments dealing with project technical performance and management assumptions are summarized in this section.

Cattle Management

No Steers

The first experiment in this catagory examines the effect of setting castration rate to zero, i.e. retaining all bull calves to be fed and slaughtered as virgin bulls. The net effect of this decision is to increase ADG performance of steers approximately 10%, and concomitantly, to reduce time spent on feed. The results are subdivided into two cases, as follows: In Case 1, bulls are fed to slaughter weight in Subsystem 4.1 on a silage/corn ration, with no use of pasture resources. The results for this case are no change in System IRR from the Base Scenario.

In Case 2, bulls are backgrounded on a 100% silage ration the first winter, at an ADG of .70 kg, followed by summer pasture and, if necessary, feeding on silage/corn the following autumn. This results in a slight improvement in System IRR from 22% to 23%. On the whole, results of the model suggest that switching to no castration production offers very small improvements in enterprise profitability which may not be justified by the additional management problems.

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[29] Depreciation is, by definition, not accounted for in any IRR calculations based on cash flow projections (See Limitations section).

No Sale of Replacement Heifers

The second cattle management experiment was to test the management assumption regarding sale of replacement heifers to other farms when there is a surplus of heifers over herd maintenance requirements. Under the Base Scenario, this sale takes place in Years 11 through 15 of the project, and amounts to a total of 1553 head exported to other farms. With small improvements in cattle performance from base assumptions, the number of replacement heifers sold to other farms increases dramatically. The change in design incorporated in the replacement heifer experiment, was to raise surplus heifers to slaughter weight (450 kg) in Component 4 on grass and silage/corn, then slaughter and sell as boxed-beef.

The change in management practice had no effect on System IRR, which remained at 22% following changes. As a further experiment, Component 3 lower level technology was increased by first a 10% and then a 20% margin, as previously reported in the sensitivity analysis section of this chapter. This generated no change of results from those reported in the original sensitivity analysis, that is, IRR remained constant at 22% in all cases.

Component 5

The following set of experiments tests the importance of the management assumption that all cull cow and bull meat is to be processed and marketed as dried-beef products. Results of the sensitivity analysis and a previous experiment have alluded to the importance of this particular management assumption. The basic change incorporated in this series of experiments is that the processing section of Component 5 is eliminated and all beef packaged and sold as frozen boxed beef. Component 5 capital costs are also reduced by 30% to account for the cost of drying and packaging equipment no longer required.

Case 1. No Price Differentiation

In this run it was assumed that the prices of all boxed beef produced by the enterprise is sold at the same price, regardless of whether it is from yearling or cull animals. Marketing costs are adjusted downward from the Base Scenario level of 10% to 7.5% of gross revenue to parallel the lower marketing intensity of this option.

The results of Case 1 for Base Scenario boxed beef price equivalent to Y5.00/kg results in a System IRR of 16%, as compared to Base Scenario level of 22%. A 20% increase in boxed beef price to $2.31/kg (Y6.00) is necessary to achieve critical level IRR of 20% under Case 1.

Case 2. Differential Price Structure

Case 2 represents a scenario where beef from herd culls is priced lower than beef from yearlings and the two grades of meat are targeted for different markets. The price of herd cull beef is assumed to be 75% of the price of medium-quality young bull/steer beef, and marketing costs return to the Base Scenario level of 10% of gross revenue.

Due to the dual price structure, direct comparison of Case 2 results with other results is not possible. A price level equivalent to Y5.00/kg for medium-quality beef and Y3.75/kg for herd cull beef results in a project IRR of only 12%. A price structure of Y7.00/kg and Y5.25/kg is necessary to achieve critical System IRR of 20%.

Component 7 Experiments

The following section reports on results of experimentation with financial environmental parameters in Component 7 (joint venture considerations) of the model. The three experiments conducted examine:

1. the effect of two different exchage rates at different periods of project life.
2. the impact of government grants on IRR and return to the two partners.
3. the effect of no buy-out of the herd assets from the joint venture in Year 15.

Two Exchange Rates

The effect of having different prevailing exchange rates during two different time periods of the project was tested in this experiment. The exchange rate for Years 6-15 of the project was left at baseline level of 2.60Y/$ and the exchange rate for Years 1-5 inclusive varied at 10% intervals, over a +50 and -30% range. The two time periods were chosen in order to separate the capital investment stage of the project from the mature stage, and determine the effect of different exchange rates during these two periods, on enterprise profitability. Results as listed in Table VI.15 show that the most favorable scenario would be a higher exchange rate (lower Yuan value) during the capital construction phase of the project.

Government Aid

The effect of government aid on project feasiblity was tested by adding a cash injection of $50,000 in Years 1-5 of the project. This cash grant is intended to correspond to maximum possible input from CIDA in the technology transfer component of its INC program (See Appendix D.). In the first instance, the credit was applied to the overall joint venture, with the result that System IRR increased from 22 to 23%. In the second case, the credit was applied only to the Canadian partner's share of cash-flow, with the result that Canadian partner's IRR increased to 23% from 21%.

No Herd Buy-out

One of the Base Scenario assumptions of the model is that the HGB or individual state farms will buy out the final herd, at replacement heifer prices in Year 15. The impact on joint venture profitability of relaxing this assumption was tested, by assuming no Year 15 income from herd sale. The results of this experiment are that System IRR declined slightly to 21%. Therefore, the herd buy-out assumption is not critical to joint venture feasibility.

Table VI.15: Effect of Differing Exchange Rates in Two Phases of the Project.

Exchange Rate Year 1-5 (%)	Exchange Rate Year 1-5 Y/$	Exchange Rate Year 6-15 Y/$	IRR6 (%)
70	1.82	2.60	20
80	2.08	2.60	21
90	2.34	2.60	21
BASE LEVEL	2.60	2.60	22
110	2.86	2.60	23
120	3.12	2.60	23
130	3.30	2.60	24
140	3.64	2.60	25
150	3.90	2.60	25

Table VI.16: Some Historical Exchange Rates, Chinese Yuan/Canadian Dollar.

Date	Exchange Rate (Y/$)
85-04-21	2.09
86-04-21	2.30
87-04-20	2.82

Source: Far Eastern Economic Review, various issues.

D. LIMITATIONS

The principal limitation of this study has been its broad scope, which, due to constraints, has resulted in cursory treatment of some aspects of the study. Thus, while it was originally intended to do a study applicable to all areas of Heilongjiang, the model coefficients are based on information from and applicable to the Three Rivers Plain region and the Heilongjiang General Bureau of State Farms orginization only. Consequently, it may be inappropriate to generalize results to beef ventures elsewhere in Heilongjiang or China.

A number of limitations of the methodology and the type of model employed in this study have been discussed in Chapter III. The simplification of the model to basic production relationships only, with minimum feedback, was necessary and, considering the results of the sensitivity analyses, not excessive. Further detail would likely have had little or no impact on key financial output of the model. Nonetheless, there is no doubt that, with refinement, the production relationships in the model could have been made more realistic. Results are somewhat sensitive to the basic structure of the hypothetical project (See Experiments section of this Chapter.), which, although based on considerable background information, is still an arbitrary construction.

A central tenet of this model is that key technological coefficients will improve over the life of the project. For a commercial technology transfer project, technological improvement seems more plausible than the assumption of zero technological improvement, since success or failure of the joint venture would rest on the ability to achieve overall technological improvement. However, there is no way of predicting what the rates of technological improvement would be; i.e. the rates of improvement given in the model are completely arbitrary. Similarly, the starting and limit values of key technological coefficients, while based on best available information for Heilongjiang and Alberta forage and beef technology applied to state farm conditions, are still only estimates.

The herd-dynamics of the cash-flow model developed have been greatly simplified. Ideally, the model of the herd might have been subdivided into three age classes - heifers, two to four year-olds, and older cows. In such a case, each group would have been assigned specific TIFs for reproductive efficiency, and specific cull rates. The more-detailed approach would have given a better picture of herd-dynamics and may have been useful for determining the most critical aspects of reproductive efficiency. It should be recognized that a detailed herd building strategy, including an in-depth investigation of possible herd-dynamics, would be required prior to the implementation of any large scale beef-production project. An insured supply of replacement dairy calves from state farm herds is a critical component of the herd development strategy described in this thesis. The assumption of improvements in cattle management over time is also critical to the herd development strategy.

The model employs a cash-flow analysis approach to address the basic issue of enterprise profitability. However, the cash flows thus calculated do not include a reduction in cash-flow for payment of enterprise income tax, and thus will somewhat overestimate net enterprise profitability. The justifications for this ommission are:

1. The primary objective of the model is to determine basic enterprise profitability, which is

still addressed within the framework adopted.

2. The investment in time to incorporate the accounting formulas and statements necessary to calculate taxable income, including depreciation schedules for all assets, is not justified by the added accuracy of IRR calculations which would result from inclusion of income tax expense.
3. A spreadsheet model incorporating tax-calculating routines would exceed computing system memory capabilities and therefore break the "portability" constraint originally imposed.
4. The enterprise income tax for this venture would, owing to its special nature and location, be relatively low (0-20%, based on interpretation of current legislation (See Appendix B.)), and therefore not of critical importance to enterprise profitability.

By definition, the IRR calculation does not include depreciation (Casler,1984) as part of the cash flow. With the exception of the breeding herd, all capital assets are assumed to deteriorate to a salvage value of zero by Year 15. Reinvestment in the capital assets of the joint venture, beyond the levels specified in the model, would necessitate a payout to the foreign partner for its share of capital assets in Year 15.

The nature of the model employed and the data collected for this study precludes formal statistical analysis of raw data. For many parameters, particularly input prices, only one value was available, the official 1986 state price. Capital costs for Chinese equipment and facilities are based on financial records of state farms, factories, and institutions in Heilongjiang, but cannot be guaranteed to be the same as costs incurred by a joint venture. More importantly, it is assumed that input and output prices will inflate at an equivalent rate, which may not be an acceptable assumption. The indirect (primarily interview) methods, employed of necessity to collect much of the data, may limit its accuracy, as there is a tendency for the manager of any organization to exaggerate its performance. While publication does not necessarily ensure credibility, it would have been desireable to have more published data available for this study.

Probably the single greatest limitation of the model is that it attempts to look 15 years into a highly uncertain future. Unfortunately, there is no ability to predict or systematically study the effect of random shocks such as periods of high inflation, exchange rate fluctuations, disease outbreaks, loss or gain of markets, etc. Analysis has been restricted to testing impact of uniform changes in key variables.

E. SUMMARY

On the whole, the investment-analysis model constructed for this study generates plausible results. Under Base Scenario assumptions, the project yields an IRR of 22%, and is an efficient generator of foreign exchange. However, cash-flow is negative for the first five years of the project. Joint venture feasibility is sensitive to environmental variables, particularly input and output prices and exchange rates. System technological efficiency is less important. The most important technology transfer assumptions are starting levels of coefficients and overall technological improvement.

Expansion of the enterprise (reinvestment) appears feasible, and extension of project lifetime improves return on investment. Changes in cattle management strategies have only slight impact on Project IRR, but the assumption of primary processing of cull cow and bull meat is important.

The best-case scenario for the joint venture would be lower Yuan value during the capital construction phase of the project than during the mature phase. Government aid enhances the joint venture return, but is not a critical determinant of project feasibility. The assumption of herd buy-out in Year 15 is not critical to project feasibility.

The study has a number of limitations in model design, methodology, and data quality, which must be recognized when interpreting results.

VII. Interpretations and Conclusions

This chapter presents an interpretation of some of the results presented in the previous chapter, followed by a presentation of the major conclusions of the research.

A. INTERPRETATIONS OF RESULTS

There are a number of implications of the results presented in Chapter VI. Most of these implications relate to the central design of a joint venture in beef-production. While the modeling process adopted does not allow determination of an optimum system design it does allow interpretations to be made with respect to most favorable system constructs.

Technology Transfer

One of the principal aspects of this study is technology transfer from Canada to China, and particularly, from Alberta to Heilongjiang. In the system design, technology is transferred within a direct-investment joint venture format. The modeling process has allowed inferences to be drawn regarding technology transfer in a beef-production joint venture.

The most important inference to be drawn with respect to technology transfer in beef production is that the technology transfer process is a very protracted process, particularly in comparison to technology transfer of physical processes. The result of unavoidable, biologically-imposed, delays in project development is that the enterprise does not become profitable until its fifth year, and payback on investment is not achieved until Year 8. In order for the joint venture to achieve an acceptable profit level, it must exist for a minimum of 15 Years. Therefore, a stable working relationship between the two partners, and a stable system environment, including political and cultural environment, must exist for an extended period, in order for a beef-production joint venture to be a success. The special problems likely to be encountered by beef-production joint ventures due to the long term nature of the technology transfer, suggest that alternatives to the joint venture should be considered. The existence of guarantees by both Canadian and Chinese governments might help alleviate concerns about impact of unforseen changes in system environment.

Another inference with regards to technology transfer is that capital technology imported by the joint venture should be entirely directed towards increasing technical efficiency, product quality, and product marketability. In no case should investment be made solely for the purpose of labor substitution. The rationale for the previous two statements is twofold:

1. lack of response of System IRR to wage rates or labor productivity in the model.
2. relatively high System IRR responsiveness to decreases in capital costs.

A third implication of the analysis, with regards to technology transfer, is that emphasis of technology should be on Components 5 (slaughter/processing) and 2 (silage), where the largest risks of project failure and highest payoffs for improved efficiency exist. Furthermore, the processing part of Component 5 is especially important. The profitability of processing is related to the abundance of low cost labor.

The larger impact of starting levels of TIFs, relative to that of either limit values or improvement rates, also has implications with respect to technology transfer in a joint venture. The primary implication is that the first two or three years of the system are critical to overall success. Failure to quickly achieve productivity levels at or above the starting values set in the Base Scenario is likely to jeopardize the system, while quickly exceeding them will considerably enhance return on investment.

Improvement rates, or more precisely the assumption of yearly improvement in technical efficiencies, are critical only for Component 5 and for the joint venture as a whole. It would appear the joint venture can survive poor technical performance in one or possibly two of the components, with the exception of Component 5, but would likely be jeopardized by ineffective technology transfer in three or more components. Thus the training and technology transfer function of Component 6 (headquarters) is important for overall success of the system.

Interpretation of Low Sensitivity to Technology

System IRR demonstrated less sensitivity to changes in technological parameters than was anticipated. The low level of response to changes in technological efficiency in any one component of the joint venture improves the overall feasibility of the system by lessening the risk of project failure due to poor performance in any one area. The low level of responsiveness also supports the decision to model production processes with straightforward formulas, rather than with detailed biological feedback loops and response mechanisms. For example, incorporating a polynomial fertiliser response function in the DMY calculation for silage production, was, in retrospect, an unnecessary complication of the model.

The relative insensitivity of System IRR to changes in a given component's technical performance is in direct contrast to the relatively high sensitivity of a component's IRR to changes in its own technical efficiency. The difference in degree of response is attributed to:

1. large size of the system relative to any one component.
2. interrelationships between components, particularly Components 3, 4, and 5.

In essence there is a buffering effect to shocks to any one component, attributable to complementary interrelationships, both simultaneous and recursive, between components, and to the large scale of the system as a whole. Thus, provided the system remains manageable, there are reductions in risk achieved by vertical integration, and by horizontal integration to the extent of producing more than one final product.

Interpretation of High Sensitivity to Financial Environmental Parameters

The high sensitivity of System IRR to financial environmental parameters, particularly output prices, is intuitive. Exogenous-price assumptions have large impacts partly because they are tested for the system as whole. Technological assumptions were, in contrast, tested component by component. When financial parameters were adjusted for only one component (Component 6), the impact on System IRR was much less than for global adjustments in financial assumptions.

System IRR sensitivity to output prices stresses the importance of Component 5 and marketing aspects of the system. Base Scenario results also imply that a cost-price squeeze would likely jeopardize the project. Two current trends which are favorable to overall feasibility are a declining value of the Yuan[30] and increasing meat prices in China.

Management and Transfer Pricing

The high degree of interrelationship between components of the joint venture in beef-production emphasizes the importance of overall management, as performed by Component 6 (headquarters). A system which does not effectively integrate the production components is likely to fail. One approach to management is to stress the financial independence of individual components and use transfer prices as a management tool.

The computer model developed in this study uses inter-component transfer prices to facilitate the study of financial performance of individual components, in addition to financial performance of the system as a whole. For the transfer prices set in the Base Scenario, IRRs for the five production components are approximately equated. Thus there is a common starting point for analysis of financial response of individual components to changes in technological and financial variables. In the cash flow model of a joint venture in beef production, IRR-equating transfer prices are are function of two forces:

1. exogenous prices.
2. performance levels as set in the computer model.

Transfer prices are set iteratively, based on the component IRR-equating criterion, until the projected return for all components is equal. Thus, if all components were to achieve the production levels specified in the computer model, they would all achieve the same financial result. Components which were more efficient than the target levels dictated in the model would attain higher rates of return, while components which were less efficient would attain lower levels of return.

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[30] At June 29,1987 exchange rate of 2.785 Y/$ (Source: **Far Eastern Economic Review.**) the Base Scenario would generate an IRR of 24% as compared to 22% reported in Chapter VI.

The transfer prices set in the model are accounting devices only. If actual transfer prices were set at these levels, all profits would be internalized in the components, and there would be no funds to finance headquarters functions. Therefore, a management system which is to include an actual cash flow between components, as opposed to a strictly "paper" flow, would require substantial adaptation of the transfer pricing methodology adopted in this model. Transfer prices would have to be adjusted downward to account for headquarters functions not paid for by the individual components, as well as returns to Chinese and foreign outside investors on capital investments.

The preceeding technique for setting transfer prices differs from common pracitice and theory of transfer pricing (Eccles,1985). Most industry transfer pricing methods are based on yearly production cost estimates, and do not account for capital costs or projected performance goals. An example is the standard variable cost (SVC) criterion established by Benke and Edwards (1980) as the best criterion for transfer price setting where there are no markets for intermediate products of the company (See Chapter III.). For a real-life management system, where exogenous prices and performance targets change frequently, a yearly transfer price setting mechanism seems more practical than the one-time transfer price setting technique employed in this study. The work performed in this study does, however, intimate that computer models similar to the one developed in this research have applications for transfer price setting in complex economic systems. And, as noted in the following section, transfer prices set by the IRR-equating technique appear to be a useful benchmark for target prices of intermediate inputs sold off-farm.

Interpretations of Experiments

Project Structure Experiments

Phased expansion of the system appears feasible if the original project is successful up to Year 5. To attract foreign investment to the expanded enterprise would probably necessitate extension of the joint venture agreement. Project extension would improve returns, given Base Scenario assumptions, and would lessen the conflict between profit extraction versus reinvestment motives of the two parties (See Appendix B.).

Technical Management Experiments

The results of the replacement heifer experiment (See Chapter VI.) may be interpreted as follows:

1. Lack of System IRR responsiveness to improvements in Component 3 technology is attributable to the inverse relationship between replacement rates and breeding performance. As the model is designed, improved breeding performance leads to lower replacement rates, which reduces throughput of cull cows through Component 5, and reduces the output of dried-beef by the project. Lack of System IRR responsiveness to improvements in Component 3 technology is *not* due to lower profitability of selling surplus heifers to other farms at transfer prices, instead of feeding and slaughtering them.
2. If transfer prices are used to equate IRRs among all five production components, then they also become a benchmark price for sale of the product(s) of any component of the system outside the system. To elaborate, transfer prices represent the minimum price any component should charge for products sold outside the system. Any products sold outside the system at prices greater than transfer prices will increase profitability of the enterprise as a whole. Put another way, financial outcome of the project is indifferent to whether or not the products of intermediate components are sold to subsequent components, or sold outside the system, provided all products are sold at transfer prices set by equating production component IRRs.

The results of the experiments with Component 5 assumptions show that processing of cull cow and bull beef is important to project profitability. To achieve a project with the same financial performance as the Base Scenario, without a processing component, would require boxed beef prices approximately 20-25% higher than those assumed under the Base Scenario. Differential marketing of the two grades of beef would slightly lessen the total extent by which prices would have to rise to achieve critical project rate of return.

Component 7 Experiments

Experiments with system financial environmental parameters, as outlined in the previous chapter, allow the following generalizations to be made:

1. Exchange rates are an important financial variable, and can have considerable effect on enterprise profitability.
2. For a project of the scale modeled or larger, government aid, at levels common in current programs, would have minimal impact on joint venture feasibility.
3. The assumption of herd buy-out in Year 15 is not critical to overall feasibility.

Economic Factors

The following section discusses the possible economic impact of a joint venture in beef-production on both Chinese and Canadian interests. The moderate scale of the joint venture suggests that the impact of one single integrated beef-production project on the economy of the Sanjiang Plain as a whole would be minimal. In contrast, the economic impact of the project on individual participating state farms would likely be quite large. Consider as evidence for this claim the results of the Base Scenario of the investment-analysis model employed in this study. From years 7 to 15, the project, as-modeled, would employ the equivalent of 366 persons each year. This may be an important consideration, as rural unemployment is likely to remain an important problem throughout China to the year 2000 (World Bank,1985). Also, specific individuals would benefit greatly through training and the pursuit of opportunities created by the joint venture. Furthermore, the general population of affected state farms would likely benefit in a number of ways from the joint venture, including an increase in the availability of beef and beef products locally.

Affected state farms would benefit through direct sale of inputs to the project, through the development of currently slack resources at no cost, through land rental, and through the improvement of soil capabilities through use of forage. Byproducts of farm enterprises, including sugar beet and cereal production, would be more readily marketed, while beef-production byproducts such as blood and bone meal would be available for enterprises such as poultry production. As shown in Table VII.1, in Year 15 of the Base Scenario, the joint venture purchases operating inputs from associated state farms to a total value of Y2,867,431 ($1,089,624). These sales are equivalent to 3.2% of State Farm 852 total gross income in 1985 (based on farm records).

As discussed in Chapter V, one of the largest benefits to the Chinese from this project is the development of a large, productive, locally-adapted beef herd, containing a high proportion of foreign genetic material, which could serve as a base for future development of the region's beef industry. An equally, or more important, benefit is the development of expertise in forage and beef-production within the state farm system.

The potential economic benefits to Canadian firms through sale of goods and services to the joint venture are large. Total foreign sourced capital goods for the Base Scenario of the modeled project have a NPV of $1,119,530 (based on 15% discount rate). Table VII.1 shows the large quantity of foreign-sourced operating inputs to be purchased by the joint venture. Furthermore, a joint venture might establish a foothold for associated firms, as suppliers to a large and growing agriculture and food processing industry in Heilongjiang.

Undoubtedly there would exist negative impacts of the project under study. For example, conflicts and difficulties are likely to arise from the introduction of western management techniques into a socialist system, and the joint venture may compete with state enterprises for allocations of scarce inputs, particularly fertilizer and electricity. However, it appears that the net economic impact of this project on the local and regional economy of its site would be positive, and that spinoff benefits comprise a large proportion of the potential benefits of a joint venture in beef-production, for both Chinese and Canadian interests. Failure of both parties to acknowledge the existence of substantial spinoff benefits from the joint venture would jeopardize joint venture negotiations.

Table VII.1: JV Domestic and Foreign Operating Input Purchases in Year 15.

Input	Value
Domestic Sourced:	
machinery operating inputs	*Y147,038*
land rental (for silage)	*882,229*
fertiliser	*102,437*
silage storage inputs	*87,831*
wheat straw (7380t)	*738,000*
corn (1107t)	*475,930*
yardage (feedlot expenses)	*400,582*
electricity	*33,384*
	======
Total domestic inputs	*Y2,867,431*
	$1,089,624
Foreign Sourced:	
machinery operating inputs	*Y198,165*
beef-production inputs	*500,000*
semen and AI	*700,000*
vet & other feedlot inputs	*411,821*
slaughter/processing inputs	*669,192*
	======
Total Foreign sourced inputs	*Y2,479,178*
	$942,088

Note: Based on exchange rate of Y2.6/$Cdn.
Source: Base Scenario output of this study's cash-flow model.

B. CONCLUSIONS

This research has applied an investment-analysis model to address the question of financial feasibility of a joint venture in beef-production under different assumptions of prices and technology. It has also gathered supplementary information on a large number of environmental factors which would potentially affect a vertically-integrated, beef-production system located in eastern Heilongjiang.

The conclusions given here pertain to a moderately-sized joint venture patterned more or less after the model developed in this research, located on the Three Rivers Plain, and involving the Heilongjiang General Bureau of State Farms and unspecified Canadian partner(s). The primary conclusions are:

1. A joint venture in beef-production is likely to yield a rate of return greater than 20%.

2. The long time required to transfer beef-production technology and develop a stable herd results in negative cash-flow for the first five years and an eight-year minimum payback period. This, in turn, necessitates a long-term commitment between the two partners, based on stable system environment. In light of the preceeding points, it appears that joint ventures involving physical transformation processes only, would be more likely to succeed than joint ventures involving transfer of biological technology.
3. Susceptability of the enterprise to price fluctuations may discourage investors.
4. An export-oriented joint venture in beef-production is within the capabilities of both of the proposed partners, but would nonetheless present a considerable logistical challenge.
5. The beef production and management systems outlined in this research could serve as a starting point for a Sino-Canadian beef-production joint venture, to be refined through experience to best system design.
6. Feasibility will be affected considerably by future changes in financial parameters.
7. The cash-flow model developed is a useful tool for studying financial aspects of project analysis and could have wider applications, for example as a negotiating tool. Recent improvements in microcomputer hardware will allow substantive and detailed analysis while still meeting the "portability" constraint outlined in this research.

The primary purpose of this research was to determine the potential for joint ventures in beef-production between Heilongjiang and Alberta interests. Financially and logistically such ventures appear feasible, but require long-term stability and commitment. As was noted earlier in this chapter, it is possible that the largest benefits to accrue to both Chinese and Canadian interests would come as a result of, not within, a successful joint venture. Venturous attitudes to risk, and interest in supplementary benefits, may be part of the reason why at least one American firm has undertaken a large-scale joint venture in beef-production with China in recent history. It is concluded that, overall, there is potential for Sino-Canadian joint ventures in beef-production.

Bibliography

Agdevco. 1985(1). "CIDA - Inception Report Dairy, Forage, and Soil Improvement Project, SF852". Agdevco. Regina.

Agdevco. 1985(2). "CIDA - Technical Report No.2 - Dairy, Forage, and Soil Improvement Project, SF852". Agdevco. Regina.

Agdevco. 1986. "CIDA - Quarterly Reports - Dairy, Forage, and Soil Improvement Project, SF852". September,June. Agdevco. Regina.

Alberta Agriculture. 1982. **A Guide to the Planning, Design, and Construction of New Abattoirs to Meet Class A Standards of the Alberta Meat Inspection Act.** (Revision of 1976 version). Alberta Agriculture. Edmonton.

Alberta Agriculture. 1986. **Agricultural Statistics Fact Sheet, 1985**. Alberta Agriculture. Edmonton.

Alberta Agriculture. 1987. **Farm Machinery Costs as a Guide to Custom Rates.** Alberta Agriculture. Edmonton.

Alberta Economic Development and Trade. 1987. **The Alberta Investment Guide.** (Reference Report). Alberta Econ. Dev. & Trade. Edmonton.

Anderson, E.H. and H.M. Vandermeulen. 1982. "An Evaluation of the Cattle/Beef Industry in Canada. A Report Submitted to Ag. Minister E.F. Whelan." Ag. Canada. Ottawa.

Anderson, W.D. 1986. **Joint Ventures in China.** Alberta Agriculture. 1986.

Araji, A.A. 1975.**Vertical Integration and Production Efficiency in Beef Cattle Operations.** Univ. of Idaho College of Ag. Bul. No. 553. Moscow, Idaho.

Austin, J.E. 1981. **Agroindustrial Project Analysis.** John Hopkins Univ. Press. Baltimore.

Bain, J.S. 1959. **Industrial Organization.** John Wiley & Sons. N.Y.,N.Y.

Benke, R.L. and J.D. Edwards. 1980. **Transfer Pricing: Techniques and Uses.** National Association of Accountants. N.Y., N.Y.

Berg, R.T. et al. 1986. "The university beef breeding project - 1986 update". in **65th Feeders' Day Report. Agriculture and Forestry Bulliten.** Univ. of Alberta. Edmonton.

Bing Ho. 1985. "Formats for Doing Business with China". unpublished lecture for China-Canada Trade Council, China Business Seminars, Dec. 11. Edmonton.

Bjorge, M. 1983. "Mission to Heilongjiang Province, Range Improvement and Development Project." Alberta Agriculture. Edmonton.

Bjorge, M. and A.W. Goettel. 1985. Albera Heilongjiang Range Improvement and Development Project. Second Progress Report." Alberta Agriculture. Edmonton.

Brown, D.G. 1986. **Partnership With China: Sino-Foreign Joint Ventures in Historical Perspective.** Westview. Boulder.

Campbell, J.B. 1956. **99 Range Forage Plants of the Canadian Prairies.** Ag Canada. Ottawa.

Casler, G.L. et al. 1984. **Capital Investment Analysis Using Discounted Cash Flows.** Third Edition. John Wiley & Sons. Toronto.

Cheng, P.L. 1984. **"China: the yellow cattle." World Animal Review** 53:2-7.

Chung Min Pang and A.J. DeBoer. 1983. "Management Decentralization on China's State Farms." **AJAE** 65: 657-66.

Conley, T.W. and P.W. Beamish. 1986. "Joint ventures in China: legal implications". **Business Quarterly**. November, 1986.

Crotty, R. 1980. **Cattle, Economics, and Development.** Commonwealth Ag. Bureau. Slough, U.K.

Crook,F.W. and F.C. Tuan. 1987. **China: Situation and Outlook Report.** ERC-USDA. Was. D.C.

Dawson, Dau, and Associates Ltd. 1984. **A Review of the Past and Current State of the Alberta Beef Processing Industry and Implications for the Future.** D&D. Calgary.

Deloitte, Haskins & Sells. 1983. **Doing Business in the PRC.** DHS. N.Y., N.Y.

Dent, J.B. and J.R. Anderson. 1971. **Systems Analysis in Agricultural Management**. John Wiley & Sons. Toronto.

Dent, J.B. and M.J. Blackie. 1979. **Systems Simulation in Agriculture.** Applied Sci. Pub. Ltd. Essex, U.K.

Durst, R.L. and J.P. Kuehn. 1979. **The Feasibility of Establishing Low Volume Beef Slaughtering-Processing Plants in West Virginia.** West Virininia, Agricultural and Forestry Experiment Station. Bulliten 666.

Eccles, R.G. 1985. **The Transfer Pricing Problem: A Theory for Practice.** D.C. Heath & Co. Toronto.

Elliot, R. 1985."The economic contract law of the PRC: a window on China's legal and economic worlds." **Canada and International Trade, Conference Papers. Vol II: Canada and the Pacific Rim.** Institute for Research on Public Policy. Vancouver.

Foote, W.C. and N.L. First. 1980. "Animal breeding and genetics." Ch. 11 in Hoefer J.A. and Tsuchitani

Foreign Languages Press. 1982. **China's Foreign Economic Legislation Vol.1.** Beijing.

Fox, K.A. and D.G. Miles. (eds.). 1987. **Systems Economics: Concepts, Models, and Multidisciplinary Perspectives.** Iowa State Univ. Press. Ames.

Fullen, Len. 1979. **Potential Areas for Increasing Beef Cattle Efficiency in Western Canada by 1990.** Alberta Agriculture. Edmonton.

Fullen, Len. 1980. **Economics of Feed Storage and Distribution Systems for Feeding Cattle.**

Alberta Agriculture. Edomonton.

Gardner, R.J. 1987. "Systems Theory in Mathematical Economics" Chap. 3 in Fox, K.A. and D.G. Miles.

GBSFH. 1986. **General Bureau of State Farms in Heilongjiang. Statistics Yearbook, 1985.** GBSFH, Jiamusi.

Gittinger, J.P. 1982. **Economic Analysis of Agricultural Projects.** John Hopkins Univ. Press, Baltimiore.

Gordon, D.V. 1986. **Multi-Output Model of the Canadian Cow-Calf Industry.** Ag. Canada. Ottawa.

Gordon, M.J. and M.L. Chan. 1986. "Joint Ventures in the PRC: Objectives, Investment and Financing". unpublished paper. Univ. of Toronto & McMaster Univ.

Hayanga, M.L. 1978. **Vertical Coordination in the Beef Industry: Packer, Retailer and HRI Linkages.** North Central Regional Project No.117 WP-22.

Henderson, D.R. and R.B. Schwart. 1977. **Vertical Coordination between Beef Cow/Calf Enterprises and Feedlots in the U.S.** WP-13, N-C Project 117.

Ho, S.P. and R.W. Huenemann. 1984. **China's Open Door Policy, The Quest for Foreign Technology and Capital: A Study of China's Special Trade.** U.B.C. Press. Vancouver.

Hoefer, J.A. and P.J. Tsuchitani (eds.). 1980. **Animal Agriculture in China: A Report of the CSCPRC Animal Sciences Delegation.** National Academy Press. Was, D.C.

Horsley, J.P. 1986. "Protecting intellectual property". **The China Business Review.** Nov.-Dec. 1986.

International Labour Office. 1985. **Small Scale Processing of Beef.** I.L.O. Geneva.

Janeway, W.H. 1986. "Doing capitalism: notes on the practice of venture capitalism". **Journal of Economic Issues. XX(2):431-41.**

Johnson, G.L. 1987. "Holistic Modelling of Multidisciplinary Subject Matter and Problem Domains". Ch 5 in Fox, K.A. and D.G. Miles (eds.).

Johnson, S.R. and G.C. Rausser. 1977. "Systems Analysis and Simulation" in Judge et al.

Judge et al. (eds.). 1977. A Survey of Agricultural Economics Literature Vol 2. Burns & MacEachern Ltd. Don Mills, Ont.

Kennedy and Churches (eds.). 1981."The Canadian Beef System". Ch 11 in **Canada's Agricultural Systems.** Fourth Edition. McGill Univ. Ste. Anne de Bellevue, Quebec.

Lamm, R.M. 1976. **Simulated Processing Costs and Rates of Return for Selected Vegetable Oil Products.** Virginia Polytechnic Research Bulletin 108. Blacksburg, Va.

Lang, M.G. 1977. **Vertical Coordination and Vertical Coordination Mechanisms: Analysis and Case Studies.** North Central Regional Project 117, WP-12.

Lawlor, M.S. 1987. "Is the Economy a Closed System? General Equilibrium and General Systems Theory". Ch 2 in Fox, K.A. and D.G. Miles.

Li, Ying. 1987. **Simulation of Economic Effects of Mechanical Technology Transfer in Cereal Agriculture.** MSc. thesis, Univ. of Alberta.

Lieberthal, K. and M. Oksenberg. 1986. "Understanding China's Bureaucracy". **The China Business Review.** Nov/Dec. 1986.

Lovering, J and J.A. McIsaac. 1981. "A timothy - beef production model for atlantic Canada". **Agricultural Systems** 7:219-233.

Lumby, Stephen. 1981. **Investment Appraisal and Related Decisions.** Nelson Canada, Don Mills.

Ma Xiu-hong. 1985. "Key Point for Making Successful Investment in China". unpublished lecture for China-Canada Trade Council, China Business Seminars, Dec. 11, Edmonton.

Maffei, R.B. 1958. "Simulation, sensitivity, and management decision rules". **J. Business** 31: 177-86.

Marv Anderson & Associates, Ltd. 1985. **Impacts of Technological and Economic Changes on Productivity in the Alberta Beef Industry.** Ag Canada. Edmonton.

Nadler, Gerald. 1967. **Work Systems Design: The Ideals Concept.** Richard D. Irwin, Homewood, Ill.

NRC-NAS. 1984. **Nutrient Requirements of Beef Cattle.**Sixth Revised Edition. National Academy Press. Was., D.C.

OECD. 1985. **Agriculture in China: Prospects for Production and Trade.** O.E.C.D., Paris.

Oldfield, J.E. 1980. "Cattle and Buffalo Production". in Hoefer J.A. and P.J. Tsuchitani (eds.).

Pang Chun Min et al. 1981. **China's State Farms.** Case Study, Harvard Business School, Boston.

Parker, John. 1987. "China's Economy" **The Economist.** August 1, 1987.

Peng Ze Min. 1986. "The Double Tier Management Form on the SFs in the PRC". unpublished paper. Heilongjiang August First Land Reclamation University, Heilongjiang.

Perkins, D.H. 1966. **Market Control and Planning in Communist China.** Harvard Univ. Press. Cambridge, Mass.

Poon, Judy. 1984. "Trade Aspects of Agriculture Related Products". in **IDEALS. Proceedings on Agriculture in China: Challanges and Opportunities.** IDEALS, Beltsville, Md.

Quirin, G.D. 1967. **The Capital Expenditure Decision.** Richard D. Irwin Inc. Homewood, Ill.

Ripman, Hugh. 1964. "Project appraisal". **Finance and Development.** 1(3):78-83.

Sicular, T. 1985. "China's grain and meat economy: recent developments and implications for trade." **AJAE** 67: 1055-62.

Simpson, J.R. and D.E. Farris. 1982. **The World's Beef Business**. Iowa State Univ. Press, Ames, Iowa.

Simyar, Farhead and K. Argheyd. 1986. "China: Crossroad to fame or failure?" **Business Quarterly** November, 1986.

Skold, K.D. et al. 1987. "Meat Export Marketing: Lessons form Successful Exporters". **Agribusiness**. 3(1):83-97.

Smalley, R.H. 1978. **Guidelines for Establishing Beefpacking Plants in Rural Areas**. USDA Agriculture Handbook Number 513.

Smith, Lyle. 1981. **Economics of Feeding Cattle in North-Central and Northern Alberta.** Alberta Agriculture. Edmonton.

Sonntag, B.H. and K.K. Klein. 1979. **A Beef-Forage-Grain Production Model for Farms in Western Canada**. Ag Canada. Ottawa.

Spedding, C.R.W. 1975. **The Biology of Agricultural Systems**. Academic Press. San Francisco.

Spedding, C.R.W. 1979. **An Introduction to Agricultural Systems**. Applied Sci. Pub. London, U.K.

Spreen, T.H. and D.H. Laughlin (eds.). 1986. **Simulation of Beef Cattle Production Systems and its Use in Economic Analysis**. Westview, Boulder, Co.

Statistics Canada. 1986. **Exports. Merchandise Trade 1985**. Minister of Supply and Services Canada. Ottawa.

Tang, R.Y. 1981. **Multinational Transfer Pricing. Canadian and British Perspectives.** Butterworths, Toronto.

Van Arsdall, R.N. 1980. "Some Economics of Animal Production" in Hoefer J.A. and P.J. Tsuchitani (eds.).

Wang Gui Chen et al. 1985. "A Development Strategy for China's Animal Husbandry". in as above (eds.) **Smashing the Communal Pot - Formulation and Development of Rural Responsibility System**. New World Press, Beijing, 1985.

Ward, C.E. 1977. **Vertical Coordination of Cattle Feeding and Slaughtering in the Cattle and Beef Subsector**. WP-14. N.C. Proj. 117.

Williams, E. and D.E. Farris. 1975. **Economics of Vertical Coordination in Beef Cattle Systems**. Texas Ag Exp. Stn. Bul. MP-1205C.

Wood, Adrian. 1984. **Economic Evaluation of Investment Projects: Possibilities and Problems of Applying Western Methods in China**. World Bank Staff Working Papers. No. 631. N.Y., N.Y.

World Bank. 1985. **China: Long Term Issues and Options. The Main Report.** and **Annex B: Agriculture to the Year 2000: Prospects and Options.** Report No. 5206-CHA. N.Y., N.Y.

Young, B.A. and G. Goodby. 1986. "A computer model of cattle bioenergetics". in **65th Annual Feeder's Day Report, July, 1986. Agric. and Forestry Bulletin Special Issue.**Univ. of Alberta. Edmonton.

Zhang Wan Shuang. 1986. "A discussion of the Contractual Structure of Production Teams in the Heilongjiang Land Reclamation Sector". unpublished paper. HALRU. Heilongjiang.

Appendix A: The Heilongjiang General Bureau of State Farms: Supplementary Information

State Farms Grow with Foreign Funds (*China Daily* article)

China Daily, Dec. 12, 1986

Foreign capital has helped China's State farms raise production and economic efficiency, an official of the State Land Reclamation Bureau said in Beijing yesterday. Since 1979, the farms absorbed about $365.7 million, Fan Xianyu, director of the bureau's project office, told a press conference. The money mainly came from the World Bank, the Food and Agricultural Organization, the European Economic Community and individual investors from North America, Europe, Southeast Asia, Japan, Hong Kong and Macao, Fan said.

The money was used to launch 50 projects in a wide range, including grain, cotton, sugar-cane, tea, and rubber production; and sideline industries such as processing, clothing, beer, toys, electronics and the construction of hotels, apartments and office buildings.

The projects were launched in various forms, including joint ventures, co-operative production, compensation trade, processing from imported materials, loans and leasing.

These projects have greatly promoted the production of the Sate farms involved, Fan said, listing as an example the Heilongjiang Reclamation Area, which with a World Bank loan developed 200,000 hectares of waste land for grain and soybean production. The grain and soybean output from the newly developed land now accounts for one-tenth of the area's total grain output.

The Guangdong Reclamation Area used a $100 million World Bank loan to plant new rubber trees and upgrade existing rubber farms. As a result, the area's rubber production rose by one-third.

Absorption of foreign funds also helped some State farms to produce national and international prize-winning products, Fan said. A Sino-French wine joint venture was set up between State farms in Tianjin and a French company producing Dynasty wine, which has won prizes from the Tianjin municipal government, the State Economic Commission, the Ministry of Agriculture, Animal Husbandry and Fisheries, and at international fairs in the German Democratic Republic and Yugoslavia since it began production in 1980.

Encouraged by the success achieved so far, Fan said, China's State farms will make even greater efforts in absorbing foreign capital during the next five years. Fan declined to give specific figures, but disclosed that 40 per cent of the money to be used by State farms for capital construction will be foreign funds. The projects to be launched between 1986 and 1990 will include the establishment of 12 farm and animal product export centres, development of new and upgrading of old rubber plantations, and the construction of seedbreeding farms.

State Farm 852 and Private Farms

(An Excerpt from Agdevco, 1985(2))

State Farm 852, as other state farms in the Three River Delta Region of eastern Heilongjiang Province, People's Republic of China was settled 30 years ago. It is located at 46°N latitude and 133 E longitude (Fig.3.1).

The total area of the farm is approximately 140,000 hectares and has a population of 60,000 people. Approximately 74,000 hectares and 16 to 20,000 people are involved in agriculture. The remaining land and people are associated with forestry and industry. Henling, a town of about 10,000 people, located near the southeastern corner of the farm is the administration headquarters. Clothing, book, grocery and a number of private stores as well as a Guest House are located along the main street. Primary and secondary schools, a hospital, administrative buildings, a radio station and a TV relay station are located near the centre of the town. A flour factory, brewery, soybean processing plant, a machinery assembly and manufacturing plant and a lumber mill are situated on the outskirts.

Administratively, the State Farm is under the jurisdiction of the General Bureau of State Farms and Land Reclamation of Beijing and Jiamasui and is within the authority of the sub bureau at Hongxinglong (Fig. 3.1). The farm is managed by a Director and a Deputy Director.

The administration is divided into 24 sections or companies (Fig. 3.2) which range from a marketing company to education through to labour. Each section is managed by a Vice Director (Fig. 3.3).

There are 17 established industrial plants (Table 3.1). These produce machinery, food products, electricity and livestock feed for the farm and for sale outside the farm. The administration plans to expand the industrial base of the farm in the future. Eleven new industries will be developed over the next two years.

Table 3.1. Industries of SF 852

1. Established Industries
    a. Machinery Manufacturer
    b. Seed Processing Machinery Manufacturer
    c. Paper Mill (Yearly: 2000 tons, Planning in 85-86 to expand to 4500 tons)
    d. Building Materials Plant (Bricks, Cement, Lime)
    e. Wood Processing Plant (Lumber Mill)
    f. Grain Processing, Oil-Extracting & Foods-Making Plant
    g. Dairy Plant (fresh milk 5 tons/day, 1987 = 30 tons/day)
    h. Eight Breweries of Liquor
    i. Three Breweries of Wine
    j. Beverage Plant
    k. Plastic Products Plant
    l. Coal Mine (Yearly: 50,000 tons - 100,000 tons)
    m. Power Plant (18,000 KW, belonging to Hongxinglong Subbureau)
    n. Beer Brewery (5,000 tons/year)
    o. Feed Mill
    p. Two Seed Processing Plants ✓
    q. Steel Factory (10,000 tons/year)
2. Industries to be Built
    a. Cannery
    b. Malt Plant (10,000 tons/year)
    c. Soybean Processing Plant
    d. Snack Foods Factory
    e. Feather Processing Plant
    f. Fibre Board Factory
    g. Jinshen Processing Plant
    h. Sugar Plant (sugar beets as raw materials)
    i. Flax Processing Plant
    j. Pottery Plant
    k. Mountain Grapes - Wine Brewery

Agriculturally, the land is divided into 7 sub farms each of which has a local administration. An Animal Breeding Station as well as Research Station is included in the farm.

The main crops are corn, grain or silage for the dairy herd, soybeans and spring wheat. Approximately 300 hectares are used for rice produce on Sub Farm 1 where water is available from the 2000 hectare (at lowest water level) reservoir for irrigation. Tree fruits such as apples and pears as well as garden vegetables are grown. Dairy production has been a small part of the agriculture industry up to the present. However, increased emphasis is being placed on dairy production.

The soil used for agriculture on the farm is mainly white and meadow clay. Both of these soils are extremely heavy and possess an extremely dense hard pan. The depth of the hard pan in the white clay is at plow depth and deeper in the meadow soils.

Each year the level of production of grain crops is dependent upon rainfall. Of the approximately 56 cm of rain, 59% falls in late June, July and August. Little snow accumulates during the winter.

All of the agricultural land on each of the Sub Farms with the exception of number 7 which is involved in land reclamation under the World Bank Base Grain Project, the Research Station and the Animal Breeding Station have been divided into family farm units. Over the last year (1984-85), 5,000 family farms, 300 of which are large have been formed. The land is leased to the family for approximately $135 C (270 yuan) per hectare per year. Machinery such as track vehicles, plows, disks, harrows, swathers and combines etc. have been either leased or sold to the private farmer. Likewise, all the cattle formerly in the possession of the S.F.852 Animal Breeding Station have been sold or leased to farmers.

There are three categories of private farms:

1. Large farms - up to 100 hectares. Cash crops, large machinery.
2. Small farms - 15 to 30 hectares. Cash crops, small equipment.
3. Specialized farms - hectares depend on special need, i.e. livestock (1 ha/herd), fruits, etc.

The Agriculture Section of SF 852 award the land, machinery and cattle to the most worthy and capable family as judged by past performance and capabilities.

Supplementary Tables

Yield from tall fescue, foxtail and reed canary varieties in 1984 - 1983 sowing.

Cultivar	White Clay					Meadow Soil					Average Yield (kg/ha)
	Harvest 1		Harvest 2		Season Total	Harvest 1		Harvest 2		Season Total	
	Height cm	Yield kg/ha	Height cm	Yield kg/ha	kg/ha	Height cm	Yield kg/ha	Height cm	Yield kg/ha	kg/ha	
Tall Fescue											
Maris Jebel											
Kenmount	95	2846	94	7117	9963	118	1875	105	7045	8920	9941
Alta	69	3137	94	7500	10637	62	4313	102	9768	9768	10202
Dovey	80	2192	88	3750	5942	43	2825	93	6333	9158	7550
Kentucky 31 (check)	91	2633	101	6212	8845						8845
Fawn	101	1542	87	5292	6834	110	3196	95	5833	9029	7931
Foxtail											
Garrison	61	2204	92	5542	7746	83	1913	119	7344	9257	8501
M. Foxtail†	52	1938	76	2332	5697	94	5171	92	2487	9407	7552
Reed Canary											
Rise (check)	55	4142	102	9312	13454	154	8479	110	10104	18583	16018
Castor	54	4229			4229	158	5125			5125	8051

† M. Foxtail Harvest 3 times in 1984

Source: Agdevco, 1986. "CIDA - Quarterly Reports - Dairy, Forage, and Soil Improvement Project, SF 852". June, 1986. Agdevco. Regina.

Yield and vigor of alfalfa varieties in the 1984 -1983 sowing, SF 852.

Cultivar	White Clay					Meadow Soil					Average Yield (kg/ha)
	Harvest 1		Harvest 2		Season	Harvest 1		Harvest 2		Season	
	Height cm	Yield kg/ha	Height cm	Yield kg/ha	Total kg/ha	Height cm	Yield kg/ha	Height cm	Yield kg/ha	Total kg/ha	
Alfalfa											
Saranac (check)	71	3054	109	4333	7387	115	6929	144	4375	11304	9345
Iroquois	69	2646	93	3479	6125	80	4688	101	3917	8605	7365
Ladak	61	1542	82	2042	3584	77	3804	92	2042	5846	4715
Blazer	58	2708	84	3042	5750	68	3417	93	2979	6396	6073
WL 202	65	2308	95	3083	5391	69	3771	94	2833	6604	5997
Weevlchek	75	3133	110	3375	6508	76	2496	85	2333	4829	5668
Trumpetor	87	4185	110	3510	7695	81	3117	99	2729	5846	6870
Regal	77	3594	106	3619	7213	89	3604	103	3417	7021	7117
WL 1210	76	2763	96	3259	6022	71	2979	89	3146	6125	6073
Prowler	59	2421	105	3437	5858	76	3463	99	3354	6817	6337
Grimm	75	2929	97	4667	7596	80	2208	110	5533	7741	7668

Source: Agdevco, 1986. "CIDA - Quarterly Reports - Dairy, Forage, and Soil Improvement Project, SF 852". June, 1986. Agdevco. Regina.

Heilongjiang General Bureau of State Farms · Selected 1985 Statistics

Statistic	Value	Unit
Resources and Production		
total area, SFs	76.580	million mu
	5.105	" ha
cropland	29.240	" mu
	1.949	" ha
native grassland	5.800	" mu
	0.386	" ha
tame hayland	1.340	" mu
	0.089	" ha
reclaimable land	12.830	" mu
	0.855	" ha
class 1 and 2 reclaimable land	1.380	" mu
	0.092	" ha
actually sewn to crops	26.740	" mu
	1.783	" ha
soybean area	11.260	" mu
	0.750	" ha
average yield, soybean	1.08	tonnes/ha
rice area	0.390	million mu
	0.026	" ha
average yield, rice	2.78	tonnes/ha
wheat area	12.270	million mu
	0.818	" ha
average yield, wheat	1.86	tonnes/ha
barley area	0.160	million mu
	0.011	" ha
average yield, barley	2.11	tonnes/ha
corn area	0.680	million mu
	0.045	" ha
average yield, corn	2.12	tonnes/ha
corn silage area	0.260	million mu
green manure	0.500	million mu
	0.033	" ha
Cattle		
milk cows	34,977	
milk production	56,024	tonnes
yellow cattle	54,000	
calving percentage, yellow cattle	54	%
slaughter, yellow cattle	5310	
slaughter as a % of inventory	9.8	%
Input Use		
area of pesticide application	12.300	million mu
	0.820	" ha
pesticide use	1974	tonnes

application area, chemical fertiliser	20.000	million mu
	1.333	" ha
fertiliser use	250.000	million tonnes
actual N	31,000	tonnes
actual P_2O_5	20,914	"
actual K	513	"
average fertiliser application rate, elemental basis	0.075	tonnes/ha
organic fertiliser use	219,359	tonnes
Output, Labor, and Productivity (based on 1980 state prices)		
system total output value	2,400	*million yuan*
agriculture output value	1,000	*" yuan*
output value/worker	4746	*yuan*
output value/worker, agriculture	3624	"
output value/worker, industry	8058	"
grain farming productivity	8.09	*tonnes/worker*
grain quota to state	4.18	*tonnes/grain worker*
tax to central government	93,270	*million yuan*
system profit	25,522	" "
system population	1,635,698	
staff	708,036	
animal husbandry staff	11,310	
animal husbandry technical staff	343	
total salary	538.550	*million yuan*
average salary	850	*yuan/worker*
Mechanization		
total farm machinery	2,895,000	*horsepower*
mechanization	11	*horsepower/100mu*
animal power	60,000	*horsepower*
large and medium tractors	215,371	
harvesters	11,067	
trucks	6547	
automobiles	1914	

Source: GBSFH, Statistics Yearbook, 1985. Jiamusi, GBSFH, 1986.

State Farm 852 - Some Costs of Production.

Item	Value	Units
LABOR		
average salary	120	Y/month
highest salary	210	" / "
lowest salary	75	" / "
LAND		

land tax	2.5	Y/mu
land use fee	20-30	" / "
serviced site	300	" / "
BUILDINGS		
metal grain bin	15,000	Y
machinery storage shed	200	Y/m²
office building	300	" / "
industrial building, 5m ceiling	350	" / "
barn	200	" / "
equiped machine shop	250	" / "
poured concrete	100	Y/m³
bricks	.06	" / "
FENCING MATERIAL		
barbed wire	2500	Y/tonne
	0.42	Y/m
smooth wire	2700	Y/tonne
	2.7	Y/m
5 x 15 cm pine lumber	300	Y/m³
asphalt coated posts	8	Y each
pipe steel	1500	Y/tonne
FEEDSTUFFS		
straw	80	Y/tonne
beet tops	100	" / "
native hay	120	" / "
soycake	660	" / "
feed corn	460	" / "
wheat bran	280	" / "
MISCELLANEOUS		
developed well	25,000	Y
5 tonne wagon	8500	"
plastic sheeting for silage	4.8	Y/kg (12.5m²)
agricultural aircraft use	60-80	Y/hour
electricity	0.18	Y /kwhr
	0.30	" / " , for over-quota use

Source: According to information provided by SF 852 accountants.

SF 852 - Costs and Retruns for 3 Crops

	COST/MU (Yuan)		
Item	Wheat	Corn	Soybean
seed	10.80	2.75	9.00
fertiliser	8.10	8.30	4.80
chemical	2.05	2.00	2.60
labor	2.40	5.40	4.50
machinery fee	11.05	10.80	12.00
transportation	2.40	2.00	3.00
others	8.40	10.50	15.30
agriculture tax	2.50	2.50	2.50
management fee	6.00	6.00	6.00
Total Expenses	53.73	50.25	59.70
yield (jin/mu)	329	408	218
income (Y/mu)	78.96	61.20	76.30
PROFIT (Y/mu)	25.23	10.85	16.60

SOURCE: State Farm 852 records
NOTES:
1. based on 1985 official state prices.
2. In Canadian costs and returns tables, "Profit" might be termed "Return to Land".
3. 15 mu = 1ha

Heilongjiang General Bureau of State Farms - SF Names and Locations.

Name	Location
Heilongjiang General Bureau Headquarters	Jiamusi
Baoquanling General Bureau	Luobei
290	Shuibin
Shuibin	" "
Jiang Bin	Luobei
Junchuan	"
Mingshan	"
Yianjun	"
Gongqeing	"
Baoquanling	"
Puyang	"
Xinha	Hegang
Tangyuan	Tangyuan
Yilan	Yilan
Wutong-he	Tangyuan

Hongxinglong General Bureau	Youyi
Youyi	Youyi
291	Jixian
597	Baoqing
852	"
853	"
Yaohe	Yaohe
Hongqiling	"
Shuangya-shan	Shuangya-shan
Jiangchuan	Huachuan
Shuguang	Huanan
Beixing	Beli
Baoshan	Huachuan
Jiansanjiang General Bureau	Hujin
859	Yaohe
Shengli	"
Hongwei	"
Qixing	Fujin
Daxing	"
Chuangyie	"
Qinde-li	Tongjiang
Qinglong-shan	"
Qianjin	"
Honghe	"
Yialu-he	"
Qianshao	Fuyuan
Qianfeng	"
Erdao-he	"
Mudangjiang General Bureau	Mishang
850	Hulin
854	"
856	"
858	"
Qingfeng	"
Yunshan	"
855	Mishan
857	"
8511	"
Xingkai-hu	"
8510	Jidong
Hailin	Hailin
Ningan	Ningan
Longyou	Baoqing
Beian General Bureau	Beian
Jinhe	Aihui
Hongsebianjiang	Sunwu
Xunke	Xunke
Longmen	Dedu
Xianghe	"
Erlong-shan	"
Longzhen	"

Yinglong-he	"
Weishan	"
Geqiu-shan	"
Changshui-he	Beian
Zhaoguang	"
Hongxing	"
Jianshe	"
Jiusan General Bureau	Nenjiang
Heshan	"
Yuejin	"
Daxi-jiang	"
Jianshan	"
Yongjun	"
Hongwuyue	"
Qixingpao	"
Nenjiang	"
Shanhe	"
Nenbei	"
Jianbian	"
Nenjiang General Bureau	Qiqihar
Keshan	Keshan
Fuyu (animal farm)	Fuyu
Chaha-ying	Gannan
Tailai	Tailai
Lusecaoyuan (animal farm)	Dumeng Autonomous County
Julang (animal farm)	Lindian
Changjiegang	Gannan
Yian	Yian
Suihua General Bureau	Suihua
Jiayin	Jiayin
Tieli	Tieli
Hailun	Hailun
Hongguang	"
Suiling	Suiling
Heping (animal farm)	Anda
Zhaoyuan	Zhaoyuan
Harbin General Bureau	Harbin
Qingyang	Yianshou
Chalin-he	Tonghe
Shahe	Fangzheng
Xiangfiang	Harbin
Qingnian	"
Yanjia-gang	"
Hongqi	"

Heilongjiang General Bureau of State Farms - Departments Directly Under Bureau Control.

Name	Location
Linyuan Petrochemical works	Daqing
Linyuan Wollen Mill	"
Yilan Harvester Plant	Yilan
Yingcun Machinery Plant	Hulin
Haolinghe Chemical Fertiliser Plant	Yichun
Xiaoling Cement Plant	Acheng
Jiamusi Food Processing Plant	Jiamusi
Printing House	"
Construction Company	Harbin
Irrigation Works Bureau	Jiamusi
Animal Husbandry and Veterinary General Station	Tangyuan
Sapling Centre	Harbin
Academy of Sciences	Jiamusi
Designing Institute	"
August First Agricultural University	Mishan
Leading Cadres Training College	Qingan
Party School	Harbin
Teachers Training College	Acheng
Economics School	Jiamusi
Economic Research Institute	Harbin
General Hospital	"
Taihu Sanatorium	Wuxi
Bei Da Huang Art Ensemble	Jiamusi
Agriculture Reclamation Newspaper Office	"
Harbin Office	Harbin
Ccmmercial Trade Company	Jiamusi
Dalian Agency	Dalian
Means of Production Company	Jiamusi
Tobacco and Liquor Company	"
Department Store	"
Agricultural Aviation Research Station	"
Preparation Agency for the Setting up of the Mansion	"
General Construction Company	"
No. 1 Construction Company	"
No. 2 Construction Company	"
No. 3 Construction Company	"
Sanjiang Food Company	"
Film Distribution Corporation	"
T.V. University	"
Elementary and Middle School	"
Second Hostel	"
Harbin Hostel	Harbin
Supply Centre	"
Supply Centre	Jiamusi
Motor Fittings Works	Harbin

Appendix B: Chinese Joint Venture Legislation

Discussion

The purpose of this appendix is to outline the evolution of China's joint venture (JV) legislation and other legislation applicable to foreign investment in China, discuss the practice and problems of Chinese JVs as outlined in the literature, and, finally, to rate the overall effect of Chinese JV legislation and policy on project feasibility. Almost the entire body of legislation applicable to JVs can be found in work referenced in this appendix. Specific sections of important recent legislation relevant to JVs is included after the discussion.

History

China's JV legislation was originally promulgated July 8, 1979, and was intended to be one of the cornerstones of the then-new "open door policy" (Ho,1984). There was, however, a considerable lag in effects of this legislation in terms of foreign investment in China, to a large extent attributable to a lack of supporting legislation and governmental bodies (Brown,1986). To date much of this legal and bureacratic deficiency has been corrected, through the creation of appropriate government bodies and the enactment of a substantial body of supporting legislation. The primary new government bodies/organizations which have been created or reorganized include the Bank of China (1980), China International Trust and Investment Corporation (CITIC), and the Ministry or Foreign Economic Relations and Trade (MFERT). Some relevant pieces of legislation which have been enacted in recent years include: JV implementing legislation, JV labor legislation, enterprise income tax law and implementing legislation, individual income tax law, foreign exchange rules, patent law, foreign contract law, and export licencing rules, to name but a few (FLP,1984) and (Ho,1985).

The effectiveness of this policy and legislation at promoting foreign investment, and JV investment in particular, has been mixed. Foreign investment peaked at an estimated $6.3 billion[31] in 1985 but dropped to about half that level in 1986. References from the mid-1980s (Anderson,1986), (Simyar et al,1986), (Gordon and Chan,1986), have attempted to identify and highlight the problems encountered by JVs up to that time. A number of recurrent complaints of foreign partners to JVs were:

1. difficulties in profit repatriation.
2. excessive foreign exchange controls.
3. inadequacies or uncertanties of Chinese commercial law.
4. bureaucratic frustrations.
5. labor incentive, management, and productivity problems.
6. overvaluation of Chinese inputs, particularly plant sites.
7. excessive and unfair local taxes and levies.

Two fundamental problems noted by Gordon and Chan (1986) are 1.) differing motives of the two partners and 2.) difficulties created by a fixed project lifespan. With respect to differing motives, typically the Chinese partner is interested in facility modernization, technology import, and foreign currency generation through export, while the foreign company wishes to acquire access to the enormous Chinese market. This conflict is less likely to be a problem in the JV under study, where foreign currency markets pay considerably better than local markets.

For the project under study the second of the two problems problem is liable to be more serious. Because the foreign partner knows his stay in the project has a set lifespan, there is the potential for conflicts in the latter years of the project, when the foreign partner will want to maximize profit extraction and the local partner will be more interested in growth and investment of the enterprise. Foreign partner involvement in setting up new beef ventures elsewhere in the SF system or provisions in the legislation allowing JV extension may somewhat abet this concern (Conley,et al,1986).

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[31] Canadian funds.

Lack of growth of foreign investment to target levels, poor progress in developing high technology JVs, and the publicity of problems associated with these ventures finally prompted the promulgation of a new and comprehensive package of legislation on October 11, 1986 entitled *Provisions of the State Council of the PRC for the Encouragement of Foreign Investment*, contained in this appendix. The 22 Article piece of legislation represents a serious attempt by the state to improve the Chinese investment climate, and, if successfully implemented, could have major impacts. The following is a simplified summary of some of the principal articles of this legislation:

1. Ceilings set for JV site use fees, and site valuations (as a component of Chinese partner contribution to the JV).
2. Priority to be given for obtaining water, electricity, transportation, and communication facilities, at local state prices.
3. Priority for short term revolving funds and other credit by Bank of China.
4. Abolishment of tax on profits remitted abroad (Formerly set at 10%).
5. Enterprise income tax rate halved:
    a. for any year when foreign exchange income exceeds 70% of total income.
    b. for three years beyond period where exemptions previously applied, i.e. up to and including the 6th profit-making year.
6. Foreign partner's share of enterprise income tax paid in previous years to be refunded if profits are reinvested in China in long term investment(s) (>=5years).
7. Exemption from consolidated industrial and income tax (formerly 1.5 to 69%, according to D,H&S (1983))
8. Streamlining of import procedures for JV inputs from abroad.
9. Permission for separate enterprises with foreign investment to mutually adjust foreign exchange deficiencies and surpluses with each other.
10. Greater enterprise autonomy of management allowed, including rights to determine wage levels and bonuses, labor management practices, etc.
11. Curbing of unfair local taxes through enforcement of *Circular of the State Council Concerning Firmly Curbing the Indescriminate Levy of Charges on Enterprises*, with JVs given the right to refuse payment of and appeal unfair levies to State Economic Commission.
12. Approval decisions by State bodies given maximum time limit of 3 months.

Implementation of a JV in Beef Production

The following section outlines the basic steps which would take place in the implementation of a JV in beef production, after first outlining the difference between and relative merits of equity versus contractual JVs. It closes with an asessment of how JV tax law might apply to a JV in beef production in eastern Heilongjiang.

Equity versus Contractual JVs

In an equity JV, the contributions of the two interests in both real and tangible assets are valuated and profits paid out according to equity share[32]. The equity JV is a distinct legal entity in China, capable of borrowing from the Bank of China and conducting all business under its own name. The *contractual JV*, in contrast, is not a distinct legal entity, but rather is an agreement between the two parties to undertake an activity for a set period of time under specific terms of investment and profit sharing set down in a contract. In practice, the contractual JV or cooperative enterprise, as it may also be referred to, has been more popular than the equity JV, particularly in the early years of the open door policy (Anderson, 1986). According to Brown (1986), the cooperative JV "served as an attractive alternative to a formal JV when bureaucratic delays hampered the approval process, but has since become less important."[33] The contractual JV has presented a practical opportunity for local and regional governments in China to circumvent the central bureacracy and enter small scale JVs (Ho,1984). Many of the contractual JVs in China are hotels, with the foreign firm supplying all financing and equipment, the Chinese providing land, labor, and management, and a third foreign firm responsible for management of the completed hotel (Ho,1985).

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[32] The contribution of the foreign partner must be greater than or equal to 25% of total capital outlay.

Despite the greater ease of establishing a cooperative JV, the equity JV has advantages for substantial and long-term foreign investments, and has been made more attractive with recent legislation. In addition to the advantages of being a distinct JV Company, an equity JV better facilitates foreign input into the management process and therefore is important for JVs where technology transfer is a complicated and long-term process (Brown,1986). The financial model employed in this study is based on a foreign minority interest equity JV.

JV Implementation

The implementation of a Sino-foreign JV is basically a three step approach as outlined below (Ma,1985). This is assuming the foreign partner has successfully identified a Chinese partner who is interested in and, more importantly, has the financial and legal capabilities of entering into a JV association.

1. **Project Proposal Report**. This is a document produced by the Chinese interest after initial contact with the foreign partner, and subsequently submitted for official approval by MFERT.
2. **Jointly Prepared Feasibility Study**. Following approval at stage one, the two parties can undertake more substantial negotiations and an in-depth feasibility study financed by both parties. The final feasibility study contains three main headings: technology, economy, and implementation. The feasibility study must address all issues pertinent to the JV including facility plans, costs and sourcing of all inputs, marketing practices, investment and management strategy, etc. Upon completion it will be submitted for approval and a decision passed within 3 months.
3. **Company Establishment**. Following approval of Step 2, negotiation of complete terms of the JV, leading to the drafting of the articles of association of that JV company takes place. The completed documents must be submitted for final approval, after which the JV becomes a legal entity in China and can undertake its business.

JV establishment can become a protracted process; thus Ma (1985) cautions against deep involvement in subsequent steps until approval at the previous stage has been obtained.

Gordon and Chan (1986) discuss some of the possible financing alternatives for a JV as well as negotiation approaches which might maximize the benefits to both interests. The most probable financing arrangements are for short and medium term credit provided by the bank of China, and capital provided in some combination of cash investment and long term credit to be provided by both Chinese and foreign sources.

Tax Considerations

Enterprise income tax rate for an equity JV as outlined under the JV Income Tax Law is 33%, and consists of a 30% state tax and a 10% local surtax. Contractual JVs are taxed under a progressive schedule at effective rates of 30 to 50%.

However, it is highly unlikely a JV in beef production located in Heilongjiang would ever pay the full 33% tax, owing to its potential eligibility for a number of tax concessions. Some tax reductions potentially applicable to the venture under study include:

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[33] Brown, D.G. 1986. **Partnership With China: Sino-Foreign Joint Ventures in Historical Perspective**. Westview, Boulder.

1. total exemption for first profit-making year in all cases.
2. 50% reduction second and third profit-making years in all cases.
3. 50% reduction for following 3 year period for technology importing JVs.
4. 50% reduction for any year exports exceed 70% of total income[34].
5. 15-30% reduction for farming JVs or JVs in remote regions (including Heilongjiang), following expiration of any other reductions.
6. Elimination of local income tax (surtax) in certain instances (subject to negotiation).
7. loss forwarding provisions for a five year period (effectively eliminating income tax for the first eight or nine years of the JV under study, given Base Scenario cash flow.)

It is difficult to predict exactly what the the net income tax for the JV would be in a given year, and there is always the possibility of further changes in tax law and rates. However, it is likely that enterprise income tax for much of the 15 year lifespan of the project is likely to be nil, for some of the final years it may be 15 or 16.5%, and in no case will it exceed 28%. Furthermore, under Article 10 of the October 1986 legislation, rebates of income tax are to be paid when associated foreign partner profits are reinvested in China.

Summary

The preceeding discussion has introduced a topic central to this study - the theory and practice of JVs in the PRC - and has attempted to relate this topic to a hypothetical JV in beef production in Heilongjiang. The general conclusion is that Chinese legislation was not particularly favorable to JVs until recently, but that provisions enacted October 11, 1986 should, if successfully implemented, greatly improve the favorability of Sino-foreign JVs. Taxation rates on JV profits for a beef production enterprise are likely to be low or nil for much of the lifespan of the project and net losses in early years of the project may allow substantial tax savings in subsequent years.

On the other hand, it remains to be seen whether or not some of the basic problems plaguing JVs previously, such as poor labor attitudes and a formidable bureaucracy, can be corrected. Furthermore, the basic construction of a JV, with its fixed time period and often conflicting motives of the two parties remains problematic. On the whole, the impact of Chinese legislation on overall enterprise feasibility is probably neutral.

Provisions of the State Council of the PRC for the Encouragement of Foreign Investment

(Promulgated on October 11, 1986)

Article 1. These provisions are hereby formulated in order to improve the investment environment, facilitate the absorption of foreign investment, introduce advanced technology, improve product quality, expand exports in order to generate foreign exchange and develop the national economy.

Article 2. The State encourages foreign companies, enterprises and other economic entities or individuals (hereinafter referred to as "foreign investors") to establish Chinese-foreign equity joint ventures, Chinese-foreign co-operative ventures and wholly foreign-owned enterprises (hereinafter referred to as "enterprises with foreign investment") within the territory of China.

The State grants special preferences to the enterprises with foreign investment listed below:

1. Production enterprises whose products are mainly for export, which have a foreign

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[34] every year of the JV under study, according to Base Scenario results.

exchange surplus after deducting from their total annual foreign exchange revenues the annual foreign exchange expenditures incurred in production and operation and the foreign exchange needed for the remittance abroad of the profits earned by foreign investors (hereinafter referred to as "export enterprises").

2. Production enterprises possessing advanced technology supplied by foreign investors which are engaged in developing new products, and upgrading and replacing products in order to increase foreign exchange generated by exports or for import substitution (hereinafter referred to as "technologically advanced enterprises").

Article 3. Export enterprises and technologically advanced enterprises shall be exempt from payment to the state of all subsidies to staff and workers, except for the payment of or allocation of funds for labor insurance, welfare costs and housing subsidies for Chinese staff and workers in accordance with the provisions of the state.

Article 4. The site use fees for export enterprises and technologically advanced enterprises, except for those located in busy urban sectors of large cities, shall be computed and charged according to the following standards:

1. Five to twenty RMB yuan per square metre per year in areas where the development fee and the site use fee are computed and charged together;
2. Not more than three RMB yuan per square metre per year in site areas where the development fee is computed and charged on a one-time basis or areas which are developed by the above-mentioned enterprises themselves.

Exemptions for specified periods of time from the fees provided in the foregoing provision may be granted at the discretion of local people's governments.

Article 5. Export enterprises and technologically advanced enterprises shall be given priority in obtaining water, electricity and transportation services, and communication facilities needed for their production and operation. Fees shall be computed and charged in accordance with the standards for local state enterprises.

Article 6. Export enterprises and technologically advanced enterprises, after examination by the Bank of China, shall be given priority in receiving loans for short-term revolving funds needed for production and distribution, as well as for other needed credit.

Article 7. When foreign investors in export enterprises and technologically advanced enterprises remit abroad profits distributed to them by such enterprises, the amount remitted shall be exempt from income tax.

Article 8. After the expiration of the period for the reduction or exemption of enterprise income tax in accordance with the provisions of the State, export enterprises whose value of export products in that year amounts to 70 per cent or more of the value of their products for that year, may pay enterprise income tax at one-half the rate of the present tax.

Export enterprises in the special economic zones and in the economic and technological development zones and other export enterprises that already pay enterprise income tax at a tax rate of 15 per cent and that comply with the foregoing conditions, shall pay enterprise income tax at a rate of 10 per cent.

Article 9. After the expiration of the period of reduction of exemption of enterprise income tax in accordance with the provisions of the State, technologically advanced enterprises may extend for three years the payment of enterprise income tax at a rate reduced by one half.

Article 10. Foreign investors who reinvest the profits distributed to them by their enterprises in order to establish or expand export enterprises or technologically advanced enterprises for a period of operation of not less than five years, after application to and approval by the tax authorities, shall be refunded the total amount of enterprise income tax already paid on the reinvested portion. If the investment is withdrawn before the period of operation reaches five years, the amount of enterprise income tax refunded shall be repaid.

Article 11. Export products of enterprises with foreign investment, except crude oil, finished oil and other products subject to special State provisions, shall be exempt from the consolidated industrial and commercial tax.

Article 12. Enterprises with foreign investment may arrange the export of their products directly or may also export by consignment to agents in accordance with State provisions. For products that require an export license, in accordance with the annual export plan of the enterprise, an application for an export license may be made every six months.

Article 13. Machinery and equipment, vehicles used in production, raw materials, fuel, bulk parts, spare parts, machine component parts and fittings (including imports restricted by the State), which enterprises with foreign investment need to import in order to carry out their export contracts do not require further applications for examination and approval and are exempt from the requirement for import licenses. The customs department shall exercise supervision and control, and shall inspect and release such imports on the basis of the enterprise contract or the export contract.

The imported materials and items mentioned above are restricted to use by the enterprise and may not be sold on the domestic market. If they are used in products to be sold domestically, import procedures shall be handled in accordance with provisions and the taxes shall be made up according to the governing sections.

Article 14. Under the supervision of the foreign exchange control departments, enterprises with foreign investment may mutually adjust their foreign exchange surpluses and deficiencies among each other.

The Bank of China and other banks designated by the People's Bank of China may provide cash security services and may grant loans in Renminbi to enterprises with foreign investment.

Article 15. The people's governments at all levels and relevant departments in charge shall guarantee the right of autonomy of enterprises with foreign investment and shall support enterprises with foreign investment in managing themselves in accordance with international advanced scientific methods.

With the scope of their approved contracts, enterprises with foreign investment have the right to determine by themselves production and operation plans, to raise funds, to use funds, to purchase production materials and to sell products; and to determine by themselves the wage levels, the forms of wages and bonuses and the allowance system.

Enterprises with foreign investment may, in accordance with their production and operation requirements, determine by themselves their organizational structure and personnel system, employ or dismiss senior management personnel, increase or dismiss staff and workers. They may recruit and employ technical personnel, managerial personnel and workers in their locality. The unit to which such employed personnel belong shall provide its support and shall permit their transfer. Staff and workers who violate the rules and regulations, and thereby cause certain bad consequences may, in accordance with the seriousness of the case, be given differing sanctions, up to that of discharge. Enterprises with foreign investment that recruit, employ, dismiss or discharge staff and workers, shall file a report with the local labour and personnel department.

Article 16. All districts and departments must implement the "Circular of the State Council Concerning Firmly Curbing the Indiscriminate Levy of Charges on Enterprises." The people's governments at the provincial level shall formulate specific methods and strengthen supervision and administration.

Enterprises with foreign investment that encounter unreasonable charges may refuse to pay and may also appeal to the local economic committees up to the State Economic Commission.

Article 17. The people's governments at all levels and relevant departments in charge shall strengthen the co-ordination of their work, improve efficiency in handling matters and shall promptly examine and approve matters reported by enterprises with foreign investment that require response and resolution. The agreement, contract and articles of association of an enterprise with foreign investment shall be examined and approved by the departments in charge under the State Council. The examination and approval authority must within three months from the date of receipt of all documents decide to approve or not to approve them.

Article 18. Export enterprises and technologically advanced enterprises mentioned in these provisions shall be confirmed jointly as such by the foreign economic relations and trade departments where such enterprises are located and the relevant departments in accordance with the enterprise contract, and certification shall be issued.

If the actual results of the annual exports of an export enterprise are unable to realize the goal of the surplus in the foreign exchange balance that is stipulated in the enterprise contract, the taxes and fees which have already been reduced or exempted in the previous year shall be made up in the following year.

Article 19. Except where these provisions expressly provide that they are to be applicable to export enterprises or technologically advanced enterprises, other articles shall be applicable to all enterprises with foreign investment.

These provisions apply from the date of implementation to those enterprises with foreign investment that have obtained approval for establishment before the date of implementation of these provisions and that qualify for the preferential terms of these provisions.

Article 20. For enterprises invested in and established by companies, enterprises and other economic organizations or individuals from Hong Kong, Macao, or Taiwan, matters shall be handled by reference to these provisions.

Article 21. The Ministry of Foreign Economic Relations and Trade shall be responsible for interpreting these provisions.

Article 22. These provisions shall go into effect on the date of issue.

Procedures of the Customs of the PRC for the Administration of Materials and Parts...
Cont'd... that Enterprises with Foreign Investment Need to Import in Order to
Perform Product Export Contracts

Article 1. These Procedures are formulated in accordance with the Provisional Customs Law of the People's Republic of China and relevant provisions of the State Council for the encouragement of foreign investment in order to encourage the re-export after processing of materials and parts that enterprises with foreign investment need to import in order to perform product export contracts and to expand exports to generate foreign exchange.

Article 2. Enterprises with foreign investment shall, in accordance with the provisions of these procedures, enjoy preferential treatment and shall undertake the obligations of declaring customs and paying taxes. The goods imported and exported by them shall be declared to the Customs strictly according to the facts. Machinery and equipment, vehicles used in production and raw materials, fuel, completely knock-downed parts, spare parts, components, sets of parts, auxiliary materials and packaging materials (hereinafter referred to as "Materials and Parts") shall be categorized as bonded goods and shall be subject to supervision and control by the Customs.

Article 3. The imported machinery, equipment, vehicles used in production, and Material and Parts referred to in Article 2 of these Procedures shall be exempted from the requirement of obtaining import licenses. The Customs shall inspect and release such imports on the basis of the enterprises contract or the import-export contract.

For products that are processed from Materials and Parts imported by enterprises with foreign investment and then re-exported, at the time of re-export, the Customs shall handle the inspection and release of such products in accordance with the provisions of the Procedures of the Ministry of Foreign Economic Relations and Trade Concerning the Application of Import and Export Licenses by Enterprises with Foreign Investment.

If Imported Materials and Parts are used in products to be sold domestically, the enterprise with foreign investment in question shall handle retroactively import procedures in accordance with the relevant provisions of the state.

Where such products belong to the category of commodities subject to the administration of import licenses, licenses for the import of goods shall be delivered to the Customs for inspection.

Article 4. The imported Materials and Parts referred to in Article 2 of these Procedures shall be exempted from import customs duties and the consolidated industrial and commercial tax if such imported Materials and Parts and used in the actual processing of products for export.

The tax free Material and Parts referred to above shall include reasonable quantities of imported catalysts, catalytic agent, abrasives, fuel and so on that are directly used in the processing of products for export and that are consumed in the production process.

Imported Materials and Parts shall be restricted to use by the enterprise that processes products for export and such products may not be sold on the domestic market. For any imported Material and Parts that are used in processed products that are, with cause and upon approval, turned to domestic sale, taxes shall be made up according to regulations. Taxes may be reduced or exempted for substandard and defective products and waste and scrap materials that are created during the production process in accordance with their use value and the exercise of discretion in light of the circumstances.

Article 5. Materials and Parts that enterprises with foreign investment need to import in order to produce products that are included in the List of Products to Replace Imports approved by the department in charge as stipulated by the state shall in light of these Procedures, be treated as bonded goods and the Customs shall exercise supervision and control. At the time of import, procedures for deferred payment of taxes shall be handled. When the products referred to above are supplied to domestic users, import customs duties and consolidated industrial and commercial tax on the imported Materials and Parts used shall be paid to the Customs, and import procedures shall be handled retroactively in accordance with provisions. If domestic users import similar types of products from abroad, they may enjoy preferential tax reduction or exemption. When enterprises with foreign investment supply the products referred to above to these users, preferential tax reduction or exemption may also be granted, provided that they shall, in accordance with the relevant provisions of the state deliver for inspection the certificate of tax reduction or exemption that has been approved by the department in charge.

Article 6. Materials and Parts purchased by enterprises with foreign investment from the bonded warehouses of relevant departments or imported by other enterprises entrusted by the enterprises with foreign investment shall be treated the same as those imported by the enterprises with foreign investment themselves and shall be handled in accordance with the relevant provisions of these Procedures.

Article 7. Enterprises with foreign investment that engage in the business of importing materials for processing shall go to the Customs in the locality (or the appropriate administrative division of Customs) with the relevant contracts to handle procedures for filing for the record and registration, and upon the examination of Customs a Manual of the Customs of the People's Republic of China for the Registration of Materials and Parts Needed to be Imported for Processing and Re-export by Enterprises with Foreign Investment In Order to Perform Product Export Contracts (hereinafter referred to as the "Registration Manual") shall be issued. Those enterprises that are qualified, upon ratification by the Customs in the locality, may be dealt with in accordance with the administrative provisions of the Customs for bonded factories that import materials for processing.

When the above-mentioned Materials and Parts are imported and, after processing, the finished products are exported, an enterprise with foreign investment shall make declarations to the Customs at the place of entry and exit by presenting the Registration Manual, three copies of the customs declaration form for imported and exported goods, the invoice for the goods, packing lists and other relevant lists and certificates. The competent Customs shall make annotations and comments, and then affix a seal on the Registration Handbook, which shall then be returned to the enterprise with foreign investment, which shall use this to handle verification and cancellation procedures at the Customs in the locality (or the appropriate administrative division of Customs).

Article 8. In respect of imported Materials and Parts imported under the items of each import contracts, within two months after the implementation and completion of the relevant contracts, enterprises with foreign investment shall present the Registration Manual, the customs declaration form for imported and exported goods and other relevant documents to Customs for handling verification and cancellation procedures.

For the situation of the import, storage and care, allocation for use and passing on to factories for processing of Materials and Parts, and the storage, export and domestic sales of the finished products after processing, enterprises with foreign investment shall set up specialized account books and shall submit quarterly statements to Customs for examination. As for products with a long production period, upon the verification and approval of Customs, such statements may be submitted every six months.

Article 9. If products processed from imported and tax-exempted Materials and Parts are, upon approval, sold domestically, then the enterprise with foreign investment shall, within one month of the date of approval, make up payment to the competent Customs the customs duties and consolidated industrial and commercial tax on the imported Materials and Parts that were originally exempted from tax.

Article 10. Except where Customs has given approval because of special reasons, enterprises with foreign investment shall, within one year of the date of import of the tax-exempted imported Materials and Parts, process them into finished products and perform the relevant contracts.

Article 11. When imported Materials and Parts after processing into finished products are not exported directly but instead are transferred to another production enterprise that continues processing the imported materials for re-export and that carries out reprocessing and assembly, the enterprise that imported the Materials and Parts shall together with such production enterprise go to Customs with the purchase and sales contract or production and processing contract signed by the two parties and other relevant documents to handle transfer and verification and cancellation procedures. Such production enterprise that carries on the business of continuing the processing of imported materials for re-export shall, in accordance with the stipulations of these Procedures, apply for a new Registration Manual, and shall comply with the relevant stipulations of these Procedures and shall accept the supervision and control of Customs.

Article 12. If after the importation of Materials and Parts any alteration, transfer, suspension or cancellation of contracts, etc, occurs, the enterprise with foreign investment concerned shall, in a timely manner, go to Customs to handle procedures for alteration, transfer, or cancellation.

Article 13. In order to facilitate the business activities of carrying out processing and export by enterprises with foreign investment and by production enterprises that carry on the business of continuing the processing of imported materials for re-export, Customs may, based on the actual situation, dispatch Customs officers to be stationed at the factories to carry out actual supervision and control, and may examine the relevant account books. The enterprises referred to above shall provide offices and necessary facilities.

Article 14. Enterprises with foreign investment may not, without authorization, transfer or sell domestically imported Material and Parts and their processed products that are bonded goods. If an enterprise concerned is found to have made a transfer, or to have sold domestically without authorization, or to have acted illegally in violation of the stipulations of these Procedures, the matter shall be dealt with by Customs in accordance with customs law and the relevant decrees and provisions of the state.

Article 15. These Procedures shall be implemented from December 1, 1986.

Appendix C: An Assessment of Canadian Industry Attitudes and Capabilities Relative to Thesis Topic

During the course of this study, representatives of a broad spectrum of Canadian firms and organizations were interviewed (See Appendix E.). The firms represented included large and small companies involved in one or all stages of the beef production process in Alberta, as well as firms with Chinese experience in consulting, genetic material sales, or project development and management. These talks, in addition to communication with various provincial government personnel have left the author with impressions as to a.) the capabilities of Canadian firms to develop a joint venture (JV) in beef production, and b.) interest in a project of this type at the commercial level.

The opinions presented represent the author's assessment of overall capabilities and attitudes and do not reflect on any specific firm or individual. Furthermore, this portion of the study did not employ generally accepted survey methodology, and resources and time did not permit contact with all, or even the majority of firms with China experience or potentially suited to some or all aspects of a JV in beef production. Nonetheless, the information collected in these interviews is pertinent to the central question of this study.

Capabilities

There can be little doubt that Canadian firms are capable of organizing, managing, and supplying appropriate technology to JVs in beef production as effectively or more effectively than firms from anywhere else. Canadian firms are among world leaders in beef genetics export, and considerable expertise exists in all other stages of the forage and beef production process. Furthermore, there exist Canadian companies with excellent records for successful implementation of large scale agricultural and agroindustrial projects throughout the world, including China. If there is a shortcoming in Canadian capabilities vis-a-vis the production process, it is in the area of international marketing of products of the venture. A Canadian firm or consortium undertaking a JV in beef production in Heilongjiang would need to place a high priority on making contacts to develop the marketing aspect of the project before organizing the more straightforward production activities.

However, production and technology transfer capabilities are only one component of the ability of firms to undertake such a project. In practice, international business and financial expertise may be the most important determinants of firm suitability to such a venture. It is the author's opinion that practical Canadian experience with commercial as opposed to aid-related agricultural and agroindustrial ventures in LDCs, including China, is limited. Canadian success in international agricultural and agro-industrial projects has primarily been in the implementation and management of projects with outside financing, and not in promoting and developing equity-based commercial ventures. Furthermore, there appears to be a reluctance by Canadian firms, including financial institutions, to explore or even consider the special approaches, including countertrade, which may be necessary to develop business opportunities in these special markets.

Attitudes

This section relates to the previous paragraph and is an assessment of the interest of Alberta firms in JVs in beef production. On the whole, there is enthusiasm at the industry level for a project of this type as a market for goods and services but not as a long term equity investment. Regardless of overall project feasibility, as determined by this or any other study, there is a reluctance on the part of Alberta firms or private investors to undertake a long-term capital investment in China's agriculture industry.

Summary

In summary, technological and managerial capabilities of Alberta firms and individuals with respect to an integrated beef production project in Heilongjiang are world class, with the possible exception of international marketing of beef and beef products. Attitudes, experience, and resources for project financing, however, are not favorable to a commercial equity-based venture of the type discussed in this study. The overriding importance of the latter concern suggests that, in summation, industry attitudes and capabilities must be judged as a negative factor with respect to likelihood of occurrence of an Alberta-Heilongjiang JV in beef production.

Appendix D: Relevant Government Programs

Depending on its scale and structure, a joint venture (JV) in beef-production could benefit from several Canadian government programs, at both federal and provincial levels. From the point of view of the Canadian partner, the availability of monetary support and investment insurance programs may make the difference between a feasible or infeasible venture. The following is a brief description of some programs potentially applicable to a Sino-Canadian JV in beef-production. Owing to the large number of business assistance programs available, it is possible that relevant programs have been ommitted from this section.

CIDA Industrial Cooperation Program

CIDA's Industrial Corporation Program (INC) was first established in 1978 (CIDA,1986) and is designed to "support Canadian private sector initiatives in long term business cooperation agreements and in project definition studies in developing countries"[35]. The program is intended to complement other government programs and to be based on the principle of risk sharing. It is composed of two sectors:

1. **Long-term Business Collaboration Section**, for firms interested in long term business associations.
   a. **Starter Study**. Preliminary study financing based on an already identified opportunity and potential partner.
   b. **Viability Study**. Financing for followup study to starter study or equivalent, leading to conclusion of JV negotiations.
   c. **Adaptation/Testing Facility**. Program would contribute financial assistance in support of an adaptation/testing facility. May be applicable to beef processing component of this project.
   d. **Project Support**. Assistance is available to a legally established JV up to $250,000 (Landry, pers.com.,1987) to cover such items as training expenses, airfares, and special equipment costs applicable to technology transfer in the JV. The purpose of the project support component of this program is to "offset certain costs incurred in the early stages of operation that are peculiar to the industrial and commercial environment of a developing country and beyond those normally incurred in a similar venture in a more industrialized country."[36].
2. **Project Definition Studies**. Funding is available under this section for up to $350,000 for Canadian firms to carry out project definition studies for capital projects, "where there is a strong possibility of project implementation (including identified financing) and a competitive supply of goods and services to subsequent stages of the project."[37]

Foreign Investment Insurance, EDC

An insurance scheme administered by the federal Export Development Corporation (EDC) provides substantial protection against three catagories of risks to Canadian investments in other countries. The program is designed to be self-financing, and therefore technically is not a government assistance program; however, this type of insurance is not commonly available through the private sector (EDC,1986). Catagories of risk insurable through the plan include:

1. **Transfer**. restrictions of transfer of earnings or equity capital back to Canada.
2. **Expropriation**. covering a broad range of interference with regular business activities.
3. **War, revolution, and insurrection**.

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[35] "Industrial Cooperation Program", folder in **The Business of Development** series, 1986. CIDA. Hull. p.3.

[36] op. cit. p.5.

[37] op. cit. p.6.

Terms of the insurance in summary are (EDC,1986):

1. Maximum insurable is up to 300% of original investment for equity securities and 200% for debt securities[38].
2. Policies can be in effect up to 15 years, with terms of insurance adjusted annually.
3. Insured investor is responsible for 10% of total losses.
4. Price consists of a small handling fee[39], plus an annual premium.
5. Separate premiums for each of the three catagories of risk, rates based on that country's risk rating (high, medium, or low catagories).
6. Premiums for all three catagories of risk for the PRC (low risk rating) total approximately 1% of insured amount.

Provincial Government Programs

In addition to federal government programs, a number of Alberta government programs may have some applicability to JVs in beef production. The following programs should be investigated by any Alberta firm contemplating an investment of this type (AEDT,1987):

1. **Alberta Intermodal Services**. Facilitation of export and import between Alberta and the west coast. May be applicable to the shipment of capital goods to Heilongjiang.
2. **Alberta Opportunity Company (AOC)**. Crown corporation intended to stimulate establishment of new businesses and expansion of existing enterprises.
3. **Export Services Support Program**. Designed to "encourage Alberta businesses to more aggressively pursue specific projects outside of Alberta by financially assisting feasibility and other relevant studies that could eventually lead to contracts for Alberta goods and services."[40]
4. **Small Business Term Assistance Program**. Fixed term, fixed rate financing. Oversubscribed at present.

Summary

Several government programs are directly applicable to a JV in beef production in China, and numerous others may or may not be appropriate. CIDA's INC program and the EDC's foreign investment insurance scheme are the two most important with respect to the project feasibility question. Canadian government programs, at both federal and provincial levels, are deemed to have a positive influence on JV feasibility.

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[38] Insurance in excess of original investment is to cover losses due to restriction on transfer of profits to Canada.

[39] between $200 and $1000.

[40] **The Alberta Investment Guide**. (Reference Report). 1987. Dep't. of Econ Dev & Trade, Gov't. of Alberta. Edmonton.

Appendix E: Some Individuals Interviewed for Purposes of this Study

NAME	ORGANIZATION
Dave Wong	Alberta Agriculture
Myron Bjorge	Alberta Agriculture
Rob Hand	Alberta Agriculture
Gibson Hanna	Alberta Agriculture
Bill Summers	Alberta Agriculture
Dave Schroeder	Alberta Agriculture
Peter Damguard	Homaid Industries
Dave Hopkins	Mirror Packers
Bill Ballantyne	Gainers
Bruce Jeffery	H.B. Jeffery Agroconsulting
Alvin Ulrich	University of Saskatchewan
Terry Lee	Agdevco
George Daugela	IBEC
Marc Landry	CIDA
David Hines	Hines & Hvidston
Dave Black	Independent Breeders
Ted Mitenko	Alta Genetics
Tony Watson	Asiatic Pacific
Bob Watson	Asiatic Pacific
Garnett Altwasser	Lakeside
Lonnie Wigemyr	Lakeside
Ray Grimson	Lakeside
Don Dufault	Western Breeders
Zhang Zi-yi	Heilongjiang August First Land Reclamation University (HALRU)
Yuang Li-hai	HALRU
Zai Yu-zhong	HALRU
Di Chao-yi	HALRU
Wu Jing-tian	HALRU
He Chang-wei	HALRU
Gao Gui-de	HALRU
Guo Qing-yu	HALRU
Li Han-chang	HALRU
Tang Jie	HALRU
Chen Shou-huang	HALRU
Sun Ching-shang	Animal Breeding Center of Heilongjiang
Sun Shen-guin	Heilongjiang General Bureau of State Farms
Xu Bu-ke	Jiamusi Food Processing Plant
Zhou Min-jun	Sanjiang Food Company
Zhang Jian-xin	SF 852
Jin Guo-zhi	SF 852

Note: List does not include all persons interviewed for purposes of this study.

Appendix F: Model Hardcopy

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STATE FARM BEEF PRODUCTION CASH FLOW MODEL
==========================================

THIS MODEL IS COMPOSED OF 7 COMPONENTS.

 COMPONENT 1: pasture
 COMPONENT 2: silage
 COMPONENT 3: cow/calf
 COMPONENT 4: finishing
 COMPONENT 5: slaughter/primary processing
 COMPONENT 6: system headquarters
 COMPONENT 7: joint venture considerations

FOR FURTHER EXPLANATION AND
DETAILS REFER TO WRITTEN DESCRIPTION OF THIS MODEL.
COMPONENT 1: PASTURE
~~~~~~~~~~~~~~~~~~~
COMMENTS/DEFINITIONS:
~~~~~~~~~~~~~~~~~~~~~~~
Intensive pasture management
SUBSYSTEM 1.1=Tame Pasture (spring and fall use)
SUBSYSTEM 1.2=Improved Range(summer use)
DMY=dry matter yield
CC=Carrying Capacity
AUM=animal unit months
AUM=450kg DM/month for animal of eqvt weight
yearling=.7AUM
bull=1.25AUM
=============================================================

COMPONENT 2: SILAGE
~~~~~~~~~~~~~~~~~~
COMMENTS/DEFINITIONS:
~~~~~~~~~~~~~~~~~~~~~~~
Low-capital "Heap Silo" technology
Pricing on basis of quality-med<16.5%CP,high>=16.5%CP
Alfalfa Silage - 2.25 cuts (zero subsystems)
Silage crop lifetime = 4 years
CP=Crude Protein
=============================================================
```

```

COMPONENT 3: COW/CALF
~~~~~~~~~~~~~~~~~~~
COMMENTS/DEFINITIONS:
~~~~~~~~~~~~~~~~~~~~~
A number of different, interrelated activities
Chief product - weaned calves for SYSTEM 4
Pasture based system, with supplemental
 feeding to minimum winter requirements of herd
Secondary products - slaughter bulls
 and cows, breeding stock
Calves - 50%male, 50%female
SUBSYSTEM 3.1=calves
SUBSYSTEM 3.2=breeding herd
B=breeding bulls
C=breeding cows
cC=cull cows
cB=cull bulls
rB=replacement bulls
rC=replacement cows
bc=bull calves
sc=steer calves
fc=female calves
ADG=average daily gain
Herd size=pregnant cows as of Jan 1
B/C Ratio=bull/cow ratio=2%
mm=manmonth
Relative performance definitions:
 birthweight fc=90%bc
 ADG, sc=90%bc
 ADG, fc=85%bc
 fall cull liveweight=110% spring cull lvwt
 cull bull lvwt=125% spring cull lvwt
Labor requirements
 if B/C=0; .36mm/head
 if B/C=.01; .14mm/head
 if B/C=.025; .08 mm/head
Breeding Success:
 CONCEPTION RATE=preg cows Oct1/herdsize
 birthrate=preg cows giving birth live calf/preg cows
   =.95, a constant
 WEANING RATE=calves weaned/live calves born
 LR=.05mm/head/365 days (manual labor)
quantity=# of head at END of feeding period
====================================================
```

```
 86
 87 COMPONENT 4: FINISHING
 88 ~~~~~~~~~~~~~~~~~~~~~
 89 COMMENTS/DEFINITIONS:
 90 ~~~~~~~~~~~~~~~~~~~~~~~
 91 Major system activity: growing weaned calves to sltr wt
 92 Secondary activity: putting wt on culls prior to sale
 93 Secondary activity: raising rH to breeding wt
 94 Secondary activity: raising dH to breeding wt
 95 replacements selected on basis of feeding performance.
 96 Heavy emphasis on use of silage and pasture in all ration
 97 Timing wrt sltr date important consideration.
 98 wB=weaned bull
 99 wS=weaned steer
100 wH=weaned heifer
101 dH=dairy heifer (from outside project)
102 yS=yearling steer
103 lS=long yearling steer(after summer grazing)
104 cB=cull bull
105 cC=cull cow
106 supp=concentrate supplement
107 SUBSYSTEM 4.1=high gain ration
108 SUBSYSTEM 4.2=backgrounding ration
109 SUBSYSTEM 4.3=summer pasture
110 SUBSYSTEM 4.4=long yearling finishing
111 pd=per day
112 Relative Performance Definitions:
113  wS=90%wB
114  wH=85%wB
115  cC=75%wB
116  dH=80%wB
117 =======================================================
```

```
118
119 COMPONENT 5: SLAUGHTER/PRIMARY PROCESSING
120 ****************************************
121 COMMENTS/DEFINITIONS:
122 **********************
123 Cattle from SYSTEM 4 and other inputs are used to
124 generate semi-stable products. All work takes place
125 at one facility. Shared capital costs and labor.
126 SUBSYSTEM 5.1=slaughter
127  5.11=cow slaughter (.94steer efficiency)
128  5.12=young bull & steer slaughter
129 SUBSYSTEM 5.2=primary processing
130 LW=avg liveweight
131 DW=avg dressed weight
132 comment: the following 3 are as a % of LW
133 D%=dressing %(carcass less waste and byproducts)
134 F%=finishing %(yield of beef)
135 W%=waste %(unusable+shrink)
136 EBP=edible byproducts(livers,tripe, edible tallow,etc.)
137 IBP=inedible byproducts(excl.hide,blood,bone meal)
138 BM=bone meal
139 pp1=primary product 1(dry beef)
140                    LW%    % OF DIFFERENCE B/W D% AND W%
141 EBP                 5.10           26.40
142 IBP                 4.50           23.30
143 BM                  3.70           19.20
144 BLOOD M             0.60            3.10
145 HIDE                5.40           28.00
```

COMPONENT 1: PASTURE
****

TECHNOLOGICAL COEFFICIENTS:
****

COEFFICIENT OR ITEM	UNITS	YEAR 1	YEAR2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15
SUBSYSTEM 1.1:																
DMY	kg/ha	0	3000	5750	6498	7212	7861	8412	8916	9362	9737	10000	10000	10000	10000	10000
utilization	%	0	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
area	ha	0	527	917	1460	2105	2897	3133	3133	3133	3133	3133	3133	3133	3133	3133
new area	ha	527	390	544	645	792	237	0	0	0	0	0	0	0	0	0
stocking rate	AUM	0	4100	8200	14760	23616	35424	41000	41000	41000	41000	41000	41000	41000	41000	41000
SUBSYSTEM 1.2:																
DMY	kg/ha	0	3000	3600	4240	4920	5610	6292	6921	7405	7776	8000	8000	8000	8000	8000
utilization	%	0	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
area	ha	0	1230	2148	3311	4622	6130	6493	6493	6493	6493	6493	6493	6493	6493	6493
new area	ha	1230	918	1163	1311	1509	363	0	0	0	0	0	0	0	0	0
stocking rate	AUM	0	4100	8592	15626	25304	38263	45389	46184	46289	46396	46505	46616	46696	46753	46757
SYSTEM 1:																
stocking rate, total	AUM	0	8200	16792	30386	48920	73687	86389	87184	87289	87396	87505	87616	87696	87753	87757
labor rqmt (LR)	man month	124	124	124	124	124	124	124	124	124	124	124	124	124	124	124
technician rqmt (TR)	man month	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
management requirement (MR)	man month	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
FINANCIAL INFORMATION:																
GROSS REVENUE:																
Grazing fees	Y/AUM	0	16.50	16.50	16.50	16.50	16.50	16.50	16.50	16.50	16.50	16.50	16.50	16.50	16.50	16.50
SUBSYSTEM 1.1:																
Revenue, per ha	Y/ha	0	128	148	167	185	202	216	216	216	216	216	216	216	216	216
Revenue	Y	0	67650	135300	243540	389664	584496	676500	676500	676500	676500	676500	676500	676500	676500	676500
SUBSYSTEM 1.2:																
Revenue, per ha	Y/ha	0	55	66	78	90	103	115	117	118	118	118	118	119	119	119
Revenue	Y	0	67650	141776	257837	417520	631344	748921	762029	763765	765532	767331	769159	770492	771432	771490
SYSTEM 1:																
Revenue, per ha	Y/ha	0	77	90	105	120	135	148	149	150	150	150	150	150	150	150
TOTAL REVENUE	Y	0	135300	277076	501377	807184	1215840	1425421	1438529	1440265	1442032	1443831	1445659	1446992	1447932	1447990
OPERATING EXPENSES:																
labor wage rate (W)	Y/month	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
technician wage rate	Y/month	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
management wage rate	Y/month	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Forage est 1.1, per ha	Y/ha	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Forage est 1.2, per ha	Y/ha	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Machinery Operation, per ha	Y/ha	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Land Rental Fee	Y/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Labor, per ha	Y/ha	9.88	5.66	3.64	2.58	1.92	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Tech, per ha	Y/ha	4.64	2.66	1.71	1.21	0.90	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Management, per ha	Y/ha	1.37	0.78	0.50	0.36	0.27	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
SUBSYSTEM 1.1:																
total op expenses, per ha	Y/ha	16	26	19	16	14	13	13	13	13	13	13	13	13	13	13
total op expenses	Y	8376	13623	17714	23341	30010	38056	40422	40422	40422	40422	40422	40422	40422	40422	40422
SUBSYSTEM 1.2:																
total op expenses, per ha	Y/ha	16	26	19	16	14	13	13	13	13	13	13	13	13	13	13
total op expenses	Y	19544	31869	40855	52290	63177	80134	83759	83759	83759	83759	83759	83759	83759	83759	83759
SYSTEM 1																
total op expenses, per ha	Y/ha	16	26	19	16	14	13	13	13	13	13	13	13	13	13	13
total op expenses	Y	27920	45491	58569	75630	93187	118190	124182	124182	124182	124182	124182	124182	124182	124182	124182
NET REVENUE																
SUBSYSTEM 1.1:																
Net Revenue, per ha	Y/ha	-16	102	128	151	171	189	203	203	203	203	203	203	203	203	203
Net Rev.nue	Y	-8376	54027	117586	220199	359654	546440	636078	636078	636078	636078	636078	636078	636078	636078	636078
SUBSYSTEM 1.2:																
Net Revenue, per ha	Y/ha	-16	29	47	62	76	90	102	104	105	105	105	106	106	106	106

```
Net Revenue                       $      -19564   33781  100921  203547  352343  551210  645161  678270  680006  681772  683371  685399  686732  687672  687731

SYSTEM 1:
NET REVENUE, per ha               $/ha      -16      31      71      99     106     122     135     137     137     137     137     137     137     138     138
NET REVENUE                       $      -27920   89809  210507  425746  711990 1097650 1301239 1314347 1316083 1317850 1319649 1321477 1322810 1323750 1323800

CAPITAL COSTS:
***************

new area development, 1.1         $      105429   77925  100714  129931  158350   47527       0       0       0       0       0       0       0       0       0
new area development, 1.2         $      109500  137719  174383  196637  226295   34377       0       0       0       0       0       0       0       0       0
new access roads                  $       65000   26000   26000   26000   26000   26000   26000       0       0       0       0       0       0       0       0
fencing                           $      115971   91258  118290  135227  158861   65682    5000    5000    5000    5000    5000    5000    5000    5000    5000
storage building and shop eqpt    $      200000       0       0       0       0       0       0       0       0       0       0       0       0       0       0
VEHICLES AND MACHINERY            $      300000       0       0       0       0       0       0       0       0       0       0       0       0       0       0
major development                 $        5000    5000    5000    5000    5000    5000    5000       0       0       0       0       0       0       0       0
TOTAL CAPITAL COSTS,COMP 1        $      900900  337902  424339  491796  574513  178586   36000    5000    5000    5000    5000    5000    5000    5000    5000
                                  $
CASH FLOW INCLUDING CAP EXP       $     -928820 -248093 -213832  -66050  137404  919264 1265239 1309347 1311083 1312850 1314649 1316477 1317810 1318750 1318800

IRR - COMPONENT 1                  Guess:      0.30
                                   Actual:     0.31
***************************************************************************
```

COMPONENT 2: SILAGE

TECHNOLOGICAL COEFFICIENTS:

COEFFICIENT OR ITEM	UNITS	YEAR 1	YEAR2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15
DMY, no fertiliser	kg/ha	0	5000	5500	5995	6475	6920	7343	7711	8019	8260	8425	8509	8594	8680	8767
DMY	kg/ha	0	5460	6010	6555	7082	7581	8038	8482	8781	9046	9227	9320	9414	9508	9604
fertiliser use (P205basis)	kg/ha	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50
CP	%	0	15.00	15.75	16.38	16.87	17.21	17.38	17.55	17.73	17.91	18.00	18.00	18.00	18.00	18.00
Area	ha	428	428	1079	1643	2314	2352	2321	2395	2211	2106	2036	2010	1986	2004	1976
Area into SYS2	ha	428	651	565	671	466	619	639	487	361	549	614	462	379	521	0
Area out of SYS2	ha	0	0	0	0	0	428	651	565	671	466	619	639	487	361	549
SILAGE WASTE	%	0	12.00	10.20	8.87	7.90	7.19	6.68	6.35	6.10	6.00	6.00	6.00	6.00	6.00	6.00
LR	mm	64	126	126	126	126	126	126	126	126	126	126	126	126	126	126
TR	mm	12	24	24	24	24	24	24	24	24	24	24	24	24	24	24
MR	mm	12	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Total Silage pdn	tonnes	0	2057	5821	9816	15095	16549	17406	18932	18230	17904	17656	17611	17572	17910	17834
Total Silage sale		0	2057	5635	9035	13438	14666	15803	17488	17126	16914	17033	17358	17436	17756	17694
FINANCIAL INFORMATION:																
REVENUE:																
Price, MDS	Y/tonne	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
Price, MDE	Y/tonne	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
effective silage price	Y/tonne	140	140	140	140	160	160	160	160	160	160	160	160	160	160	160
GROSS REVENUE, PER HA	Y/ha	0	673	731	770	929	998	1090	1168	1239	1285	1339	1382	1405	1418	1433
TOTAL GROSS REVENUE	Y	0	287970	788852	1264923	2150054	2346546	2528534	2798046	2740101	2706292	2725309	2777247	2789794	2840996	2831033
OPERATING EXPENSES:																
Storage, per quantity	Y/tonne	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Crop Est, per new area	Y/ha	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Fertiliser cost(P205 basis)	Y/tonne	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045
crop est, per ha (total area basis)	Y/ha	200.00	303.98	104.70	81.63	40.27	52.64	55.07	40.66	32.64	52.14	60.28	46.02	38.17	51.96	0.00
Machinery op, per ha	Y/ha	0.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
land rental, per ha	Y/ha	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00
labor, per ha	Y/ha	20.93	41.21	16.35	10.73	7.62	7.50	7.60	7.37	7.98	8.38	8.67	8.78	8.88	8.80	8.93
tech labor, per ha	Y/ha	4.77	9.53	3.78	2.48	1.76	1.73	1.76	1.70	1.85	1.94	2.00	2.03	2.05	2.04	2.07
management, per ha	Y/ha	5.61	11.21	4.45	2.92	2.07	2.04	2.07	2.00	2.17	2.28	2.36	2.39	2.42	2.40	2.43
fertiliser, per ha	Y/ha	0.00	52.25	52.25	52.25	52.25	52.25	52.25	52.25	52.25	52.25	52.25	52.25	52.25	52.25	52.25
storage, per ha	Y/ha	0.00	24.02	26.12	27.49	29.03	31.18	34.05	36.51	38.73	40.16	41.84	43.18	43.90	44.30	44.78
total op expenses, per ha	Y/ha	681.30	1042.13	807.69	777.50	733.02	747.34	752.79	740.50	735.62	757.15	767.39	754.63	747.67	761.74	710.46
crop est	Y	85620	130101	112969	134153	93200	123806	127791	97369	72166	109792	122702	92499	75791	104116	0
machinery op	Y	0	32107	88895	123259	173566	176400	174048	179606	165812	157925	152670	150761	148935	150294	148165
MACHINERY OP	Y	0	32107	88895	123259	173566	176400	174048	179606	165812	157925	152670	150761	148935	150294	148165
land rental	Y	192644	192644	485372	739552	1041396	1058450	1044207	1077637	994874	947549	916018	904567	893609	901765	888993
labor	Y	8960	17640	17640	17640	17640	17640	17640	17640	17640	17640	17640	17640	17640	17640	17640
tech personnel	Y	2040	4080	4080	4080	4080	4080	4080	4080	4080	4080	4080	4080	4080	4080	4080
management	Y	2400	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800
fertiliser	Y	0	22360	56357	85870	120910	122890	121253	125126	115516	110021	106380	105030	103758	104705	103222
storage	Y	0	10285	28173	45176	67189	73330	79017	87439	85620	84572	85166	86789	87181	88781	88470
Total Op Expenses	Y	291664	446133	871182	1277788	1696354	1757821	1746964	1773303	1626329	1594304	1562104	1516927	1484729	1526475	1403535
NET REVENUE, per ha	Y/ha	-681	-369	-76	-8	196	250	337	428	504	528	571	627	657	656	723
NET REVENUE	Y	-291664	-158163	-82330	-12865	453701	588726	781570	1024743	1113772	1111988	1163204	1260320	1305065	1314521	1427497
CAPITAL COSTS:																
VEHICLES AND MACHINERY	Y	300000	0	300000	0	0	0	0	0	0	0	0	0	0	0	0
silage storage facility	Y	30000	0	0	30000	0	0	0	0	0	0	0	0	0	0	0
storage building and shop eqpt	Y	100000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL COSTS, COMPONENT 2	Y	430000	0	300000	30000	0	0	0	0	0	0	0	0	0	0	0
CASH FLOW INCLUDING CAPITAL EXP	Y	-721664	-158163	-382330	-42865	453701	588726	781570	1024743	1113772	1111988	1163204	1260320	1305065	1314521	1427497

IRR - SYSTEM 2
Guess: 0.30
Actual: 0.31

SYSTEM 3: COW/CALF

TECHNOLOGICAL COEFFICIENTS:

COEFFICIENT OR ITEM	UNITS	YEAR 1	YEAR2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15
SUBSYSTEM 3.1:																
BIRTH WEIGHT, bc	kg	0	0	35	37	39	41	42	43	43	43	44	44	45	45	45
ADG, bc	kg/day	0	0	0.70	0.77	0.83	0.88	0.92	0.94	0.96	0.97	0.98	0.99	1.00	1.00	1.00
weaning age	days	0	0	180	180	180	180	180	180	180	180	180	180	180	180	180
WEANING RATE	%	0	0	80.00	84.00	87.36	89.11	90.00	90.90	91.81	92.73	93.65	94.59	95.00	95.00	95.00
sale weight, bc	kg	0	0	161	176	189	199	207	213	216	219	221	223	225	225	225
castration rate	%	0	0	50	50	50	50	50	50	50	50	50	50	50	50	50
bc for sale to SYSTEM 4.1	hd	0	0	124	272	530	891	1377	1626	1659	1692	1726	1761	1786	1804	1805
sc for sale to SYSTEM 4.2	hd	0	0	124	272	530	891	1377	1626	1659	1692	1726	1761	1786	1804	1805
fc for sale to SYSTEM 4.3	hd	0	0	247	545	1060	1782	2754	3252	3317	3384	3452	3521	3572	3608	3610
SUBSYSTEM 3.2:																
HERD SIZE	hd	0	1000	2000	3600	5760	8640	10000	10000	10000	10000	10000	10000	10000	10000	10000
post-calving cull rate	%	0	0.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
CULL COW LVWT	kg	0	450	473	491	506	516	521	527	532	537	543	548	550	550	550
early spring pasture reqts	AUM	0	1025	2050	3690	5904	8856	10250	10250	10250	10250	10250	10250	10250	10250	10250
summer pasture reqts	AUM	0	4100	8200	14760	23616	35424	41000	41000	41000	41000	41000	41000	41000	41000	41000
fall pasture reqts	AUM	0	3075	6150	11070	17712	26568	30750	30750	30750	30750	30750	30750	30750	30750	30750
MORTALITY	%	0	5.00	3.75	2.93	2.37	2.01	1.79	1.67	1.60	1.55	1.52	1.51	1.50	1.50	1.50
CONCEPTION RATE	%	0	65.00	68.25	70.98	73.11	74.57	75.32	76.07	76.83	77.60	78.38	79.16	79.95	80.00	80.00
fall replacement rate	%	0	35.00	31.75	29.02	26.89	25.43	24.68	23.93	23.17	22.40	21.62	20.84	20.05	20.00	20.00
replacement heifer/cow reqt	hd	1000	1400	2510	3670	5141	4595	3648	3560	3477	3395	3315	3235	3155	3150	3150
outside heifer	hd	1000	1162	1981	2633	3390	1881	439	284	174	6	6	6	0	0	0
Winter Ration Reqts:																
wheat straw, [illegible]	tonnes	0	185	1476	2657	4251	6376	7380	7380	7380	7380	7380	7380	7380	7380	7380
silage	tonnes	0	110	882	1587	2539	3808	4408	4408	4408	4408	4408	4408	4408	4408	4408
B/C ratio		0	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
quantity, B	hd	0	20	40	72	115	173	200	200	200	200	200	200	200	200	200
cull rate, B	%	0	0.00	10.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00
replacement bull requirements	hd	0	21	46	114	181	271	314	313	313	313	313	313	313	313	313
bulls to SYS5	hd	0	0	4	40	63	95	110	110	110	110	110	110	110	110	110
LR, ph	mm/hd	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
LR	mm	0	260	520	936	1498	2246	2600	2600	2600	2600	2600	2600	2600	2600	2600
TR, ph	mm/hd	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
TR	mm	70	70	140	252	403	605	700	700	700	700	700	700	700	700	700
[illegible]	mm	36	36	36	36	49	74	86	86	86	86	86	86	86	86	86
[illegible]	persons	3	3	3	3	4	6	7	7	7	7	7	7	7	7	7

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FINANCIAL INFORMATION:
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REVENUE:
price, weaned hc              Y/kg       4.35     4.35     4.35     4.35     4.35     4.35     4.35     4.35     4.35     4.35     4.35     4.35     4.35     4.35     4.35
price, weaned sc              Y/kg       4.15     4.15     4.15     4.15     4.15     4.15     4.15     4.15     4.15     4.15     4.15     4.15     4.15     4.15     4.15
price, weaned fc              Y/kg       3.95     3.95     3.95     3.95     3.95     3.95     3.95     3.95     3.95     3.95     3.95     3.95     3.95     3.95     3.95
price, cC                     Y/kg       3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.50
price, cB                     Y/kg       3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.40     3.50
revenue, hc                   Y             0        0    86493   208131   435056   772169  1238535  1503221  1561033  1608334  1637068  1707279  1746013  1763558  1766644
revenue, sc                   Y             0        0    74265   178706   373540   663000  1063432  1290697  1300336  1380949  1422793  1465905  1499163  1515903  1516877
revenue, fc                   Y             0        0   135225   325270   679744  1206242  1934600  2347826  2437098  2511769  2587878  2666293  2726042  2757518  2759213
revenue, cC                   Y             0   509050  1443400  2521498  3923249  5750643  6386322  6503837  6417546  6327350  6233149  6134081  5999113  5984000  6160000
revenue, cB                   Y             0        0     8033    82703   136294   200330   243767   246203   248667   251156   253665   256202   257125   257125   264600

TOTAL REVENUE, PER HEAD       Y/head        0        0      148      198      258      306      424      514      534      550      567      584      597      604      604
TOTAL REVENUE                 Y             0        0   295903   712114  1488347  2641412  4236367  5141743  5339267  5501052  5647740  5839678  5972018  6039020  6042734

OPERATING EXPENSES:
Prices:
 wheat straw                  Y/tonne     100      100      100      100      100      100      100      100      100      100      100      100      100      100      100

Costs:
spring pasture                Y             0    16913    33825    60885    97416   146124   169125   169125   169125   169125   169125   169125   169125   169125   169125
summer pastur              Y            0    67650   135300   243540   389664   584496   676500   676500   676500   676500   676500   676500   676500   676500   676500
winter pasture                Y             0    50738   101475   182655   292240   438372   507375   507375   507375   507375   507375   507375   507375   507375   507375
wheat straw                   Y             0    18450   147600   265680   425088   637632   738000   738000   738000   738000   738000   738000   738000   738000   738000
silage                        Y             0    15426   123410   222138   406195   609293   705200   705200   705200   705200   705200   705200   705200   705200   705200
SUPPLEMENTARY INPUTS          Y             0    50000   100000   180000   288000   432000   500000   500000   500000   500000   500000   500000   500000   500000   500000
SEMEN/AI SUPPLIES             Y             0    70000   140000   252000   403200   604800   700000   700000   700000   700000   700000   700000   700000   700000   700000
MACHINERY OPERATION           Y             0     5000    10000    18000    28800    43200    50000    50000    50000    50000    50000    50000    50000    50000    50000
labor                         Y             0    36400    72800   131040   209664   314496   364000   364000   364000   364000   364000   364000   364000   364000   364000
technicians                   Y         11900    11900    23800    42840    68544   102816   119000   119000   119000   119000   119000   119000   119000   119000   119000
management                    Y          7200     7200     7200     7200     9884    14826    17160    17160    17160    17160    17160    17160    17160    17160    17160
Total Operating Expenses      Y         19100   349676   895410  1605978  2618703  3928055  4546360  4546360  4546360  4546360  4546360  4546360  4546360  4546360  4546360

PER HEAD COST,(based on herd size)
spring pasture                Y/hd          0    16.91    16.91    16.91    16.91    16.91    16.91    16.91    16.91    16.91    16.91    16.91    16.91    16.91    16.91
summer pastur              Y/hd         0    67.65    67.65    67.65    67.65    67.65    67.65    67.65    67.65    67.65    67.65    67.65    67.65    67.65    67.65
winter pasture                Y/hd          0    50.74    50.74    50.74    50.74    50.74    50.74    50.74    50.74    50.74    50.74    50.74    50.74    50.74    50.74
wheat straw                   Y/hd          0    18.45    73.00    73.00    73.00    73.00    73.00    73.00    73.00    73.00    73.00    73.00    73.00    73.00    73.00
silage                        Y/hd          0    15.43    61.71    61.71    70.52    70.52    70.52    70.52    70.52    70.52    70.52    70.52    70.52    70.52    70.52
SUPPLEMENTARY INPUTS          Y/hd          0    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00
SEMEN/AI SUPPLIES             Y/hd          0    70.00    70.00    70.00    70.00    70.00    70.00    70.00    70.00    70.00    70.00    70.00    70.00    70.00    70.00
MACHINERY OPERATION           Y/hd          0     5.00     5.00     5.00     5.00     5.00     5.00     5.00     5.00     5.00     5.00     5.00     5.00     5.00     5.00
labor                         Y/hd          0    36.40    36.40    36.40    36.40    36.40    36.40    36.40    36.40    36.40    36.40    36.40    36.40    36.40    36.40
technicians                   Y/hd          0    11.90    11.90    11.90    11.90    11.90    11.90    11.90    11.90    11.90    11.90    11.90    11.90    11.90    11.90
management                    Y/hd          0     7.20     3.60     2.00     1.72     1.72     1.72     1.72     1.72     1.72     1.72     1.72     1.72     1.72     1.72
Total Op Expenses             Y/hd          0   349.68   447.71   446.11   454.64   454.64   454.64   454.64   454.64   454.64   454.64   454.64   454.64   454.64   454.64

NET REVENUE                   Y        -19100  -349676  -599427  -893864 -1130357 -1286643  -309793   595383   792907   954692  1121380  1293118  1425658  1492660  1496374
NET REVENUE, per head         Y/head        0     -350     -300     -248     -196     -149      -31       60       79       95      112      129      143      149      150

CAPITAL COSTS:
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dH (from SYS4) YRS NOT FR SYS4'  Y     231000   871741  1613448  2294253  3110263  1786680   427948   281721   133738        0        0        0        0        0        0
rH (from SYS4)                Y             0        0   117250   278923   569786   980246  1513916  1858403  1950059  2028002  2090753  2154904  2208195  2251509  2272407
rB (from SYS4)                Y             0     3700    66899   179235   300619   464192   542625   560842   574306   582970   588603   594512   599940   603520   606809
sales of herd inventory       Y             0  -589050 -1451473 -2604200 -4059543 -5967172 -6830089 -6750042 -6666213 -6578503 -6486814 -6391042 -6251238 -6241125 -6424600 END VALUE
Total Breeding Herd Investment  Y      231000   286471   346124   148211   -78875 -2736046 -4345600 -4049076 -4008110 -3967531 -3807378 -3641627 -3443104 -3386096 -3545471 19250000
buildings and shelters        Y       1090000        0        0        0   750000        0        0        0        0        0        0        0        0        0        0
MACHINERY AND EQUIPMENT       Y        250000        0        0        0   250000        0        0        0        0        0        0        0        0        0        0
TOTAL CAPITAL COSTS, COMPONENT 3  Y   1571000   286471   346124   148211   921125 -2736046 -4345600 -4049076 -4008110 -3967531 -3807378 -3641627 -3443104 -3386096 -3545471

CASH FLOW INCLUDING CAP EXP   Y      -1590100  -636147  -945551 -1042075 -2051482  1449403  4035807  4644460  4801017  4922223  4920757  4934744  4868761  4878756  5041845

IRR - COMPONENT 3                 Guess:     0.30
                                  Actual:    0.32
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COMPONENT 4: FINISHING

TECHNOLOGICAL COEFFICIENTS:

COEFFICIENT OR ITEM	UNITS	YEAR 1	YEAR2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14
SUBSYSTEM 4.1:															
ADG, w8	kg/day	0	0.0	0.8	0.9	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.3	1.3
ADG, r8	kg/day	0	0.0	0.7	0.8	0.9	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.2
ADG, d8	kg/day	0	0.6	0.7	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
total intake, w8	kg/day	0	0.0	9.9	10.3	10.6	10.9	10.9	11.4	11.4	11.4	11.4	12.0	12.0	12.0
total intake, r8	kg/day	0	0.0	6.3	6.8	6.9	7.3	7.3	7.7	7.7	7.7	7.7	7.7	7.7	8.1
total intake, d8	kg/day	0	6.3	6.5	6.8	6.9	6.9	6.9	7.3	7.3	7.3	7.3	7.3	7.3	7.3
silage rqmt, pd, w8	kg/dy/hd	0	0.0	8.9	9.3	9.4	9.8	9.8	10.3	10.3	10.3	10.3	10.8	10.8	10.8
silage rqmt, pd, r8	kg/dy/hd	0	0.0	5.9	6.1	6.2	6.6	6.6	6.9	6.9	6.9	6.9	6.9	6.9	7.3
silage rqmt, pd, d8	kg/dy/hd	0	5.7	5.9	6.1	6.2	6.2	6.2	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Total silage rqmt	tonnes	0	1977	4291	6530	9385	8509	8010	9252	8968	8778	8888	9205	9269	9587
supp rqmt, pd, w8	kg/dy/hd	0	0.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2
supp rqmt, pd, r8	kg/dy/hd	0	0.0	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8
supp rqmt, pd, d8	kg/dy/hd	0	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Total supp rqmt	tonnes	0	220	477	726	1093	945	890	1028	996	975	980	1023	1030	1065
avg # days on ration, w8	days	0	0	424	362	316	283	260	245	235	228	224	220	217	214
avg # days on ration, r8	days	0	0	270	255	240	225	210	210	210	210	210	210	210	210
avg # days on ration, d8	days	0	300	300	300	300	300	300	300	300	300	300	300	300	300
final wt, r8	kg	0	0	226	240	249	253	252	261	268	273	276	278	281	284
final wt, d8	kg	0	227	250	272	290	306	317	325	331	334	337	340	343	346
quantity, w8	hd	0	0	116	262	315	871	1352	1601	1635	1670	1705	1739	1765	1783
quantity, r8	hd	0	0	238	529	1037	1751	2714	3209	3276	3343	3412	3481	3531	3566
r8 FOR SALE OFF FARM	hd	0	0	0	0	0	0	0	0	0	0	97	246	376	416
quantity, d8 (to purchase)	hd	1050	1210	2020	2698	3462	1961	478	292	139	2	0	0	0	0
MORTALITY	%	0	5.00	4.00	3.32	2.86	2.54	2.31	2.17	2.09	2.02	2.00	2.00	2.00	2.00
Total Gain, SUBSYSTEM 4.1	kg	0	223130	511502	816434	1247261	1148948	1090912	1254119	1251720	1249066	1270985	1309340	1333451	1354937
LU	AU	0	48	97	140	196	165	144	150	152	148	151	153	154	155
SUBSYSTEM 4.2															
ADG, y8(target)	kg/dy	0	0	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
SILAGE RQMT, pd, y8	kg/dy/hd	0	0	7.90	7.90	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Total silage rqmt	tonnes	0	0	234	516	934	1604	2479	2927	2986	3046	3107	3169	3215	3247
days on ration	days	0	0	240	240	240	240	240	240	240	240	240	240	240	240
final wt, y8	kg	0	0	309	312	314	323	330	333	339	341	343	345	346	347
quantity	hd	0	0	123	272	330	891	1377	1626	1659	1692	1726	1761	1786	1804
MORTALITY	%	0	0	5.00	4.00	3.32	2.86	2.54	2.31	2.17	2.09	2.02	2.00	2.00	2.00
Total Gain, SUBSYSTEM 4.2	kg	0	0	17779	39210	76341	128329	198309	234130	238845	243645	248543	253539	257186	259738
LU	AU	0	0	4	9	17	29	45	53	55	56	57	58	59	59
SUBSYSTEM 4.3															
ADG, y8	kg/dy	0	0	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.1
days on pasture, y8	days	0	0	120	120	120	120	120	120	120	120	120	120	120	120
final wt, 18	kg	0	0	373	395	414	430	442	452	459	463	466	470	472	474
quantity, 18	hd	0	0	123	271	328	887	1372	1620	1653	1686	1720	1755	1789	1798
MORTALITY	%	0	0	2.00	1.70	1.48	1.33	1.22	1.14	1.08	1.04	1.01	1.00	1.00	1.00
stocking rate	AUM	0	0	392	866	1600	2839	4389	5104	5289	5396	5505	5616	5696	5753
Total Gain, SUBSYSTEM 4.3	kg	0	0	10303	25019	52647	94741	153779	180879	198493	206562	212843	219798	224677	229193
LU	AU	0	0	2	4	9	15	23	27	27	28	28	29	29	30
SUBSYSTEM 4.4															
ADG, 18	kg/dy	0	0	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.1
Total intake, pd, 18	kg/dy	0	0	11.5	11.9	11.4	11.9	11.9	12.5	12.5	12.5	12.5	12.5	13.0	13.0
silage rqmt, pd, 18	kg/dy/hd	0	0	10.4	10.7	10.3	10.7	10.7	11.3	11.3	11.3	11.3	11.3	11.7	11.7
Total silage rqmt	tonnes	0	0	230	393	580	795	907	901	764	684	631	576	545	515
supp rqmt, pd, 18	kg/dy/hd	0	0	1.2	1.2	1.1	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total supp rqmt	tonnes	0	0	25	44	62	83	101	100	85	76	70	64	61	57
days on ration	days	0	0	182	137	108	79	62	50	41	36	33	29	26	24
quantity	hd	0	0	121	269	325	885	1369	1617	1651	1684	1719	1753	1779	1797
MORTALITY	%	0	0	2.00	1.70	1.48	1.33	1.22	1.14	1.08	1.04	1.01	1.00	1.00	1.00
Total Gain, SUBSYSTEM 4.4	kg	0	0	15434	28376	45403	61894	79132	77832	67980	62044	57820	53337	48766	46760
LU	AU	0	0	3	5	7	10	12	11	9	8	8	7	6	6
SYSTEM 4:															
LU	AU	24	72	130	182	253	242	240	273	267	264	267	270	272	274
[illegible]	AU	48	48	48	48	48	48	48	48	48	48	48	48	48	48
[illegible]	AU	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Total silage rqmt	tonnes	0	1977	4755	7439	10899	10908	11396	13080	12718	12507	12626	12950	13029	13349

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FINANCIAL INFORMATION:
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supp price                            ¥/tonne   430.00   430.00   430.00   430.00   430.00   430.00   430.00   430.00   430.00   430.00   430.00   430.00   430.00   430.00
VET & OTHER PRICE, 4.1 & 4.2          ¥/hd       50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00    50.00
VET & OTHER PRICE, 4.3 & 4.4          ¥/hd       10.00    10.00    10.00    10.00    10.00    10.00    10.00    10.00    10.00    10.00    10.00    10.00    10.00    10.00
yardage                               ¥/hd/d.     0.25     0.25     0.25     0.25     0.25     0.25     0.25     0.25     0.25     0.25     0.25     0.25     0.25     0.25
price, dM FROM OUTSIDE                ¥/kg        3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00
price, steers & bulls                 ¥/kg        3.90     3.90     3.90     3.90     3.90     3.90     3.90     3.90     3.90     3.90     3.90     3.90     3.90     3.90
price, rH                             ¥/kg        4.45     4.45     4.45     4.45     4.45     4.45     4.45     4.45     4.45     4.45     4.45     4.45     4.45     4.45
price, dM to SYS3                     ¥/kg        3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00
                                      ¥/kg
SUBSYSTEM 4.1
 sales to SYS5                        ¥              0        0   226846   509956  1004124  1699410  2636877  3121442  3189179  3256325  3323844  3381911  3441402  3476270
 sales to SYS3                        ¥              0   875521  1797597  2752411  3900668  3231126  2484489  2700966  2658103  2610972  2679436  2749416  2806175  2855029
 sales to other farms                 ¥              0        0        0        0        0        0        0        0        0        0   119270   305012   470517   525735
 Total Revenue                        ¥              0   875521  2024443  3262367  4904792  4930537  5121362  5822407  5847281  5867297  6122550  6436339  6720050  6857034
 cattle purchase SYS3                 ¥              0        0   221710   533409  1114799  1970412  3173135  3851047  3990931  4120163  4244946  4373572  4472055  4522076
 cattle purchase, dM                  ¥              0   127039   212976   203204   167536   205055    50201    30676    14554      240        0        0        0        0
 silage                               ¥              0   276751   600720   915252  1301545  1261799  1201500  1400369  1430949  1404403  1422002  1472777  1483070  1522676
 supp                                 ¥              0    94447   205007   312340   440370   406529   382694   442961   420492   419370   424649   439788   442861   450032
 VET & OTHER                          ¥              0    50107   116739   171100   247124   225173   225256   254662   252242   250664   259017   261016   264709   267440
 yardage                              ¥              0    87160   176924   250076   357176   301130   263263   287779   277949   270046   274765   278559   280991   282765
 labor                                ¥              0     6686    13572    19552    27000    23101    20196    22076    21322    20777    21073    21369    21555    21692
 Total costs                          ¥              0   650190  1547656  2489917  4059952  4501667  5396325  6368609  6420439  6486404  6643273  6847081  6966121  7086891
 costs/gain                           ¥/kg           0     2.34     2.18     2.05     2.07     2.02     1.98     1.98     1.93     1.89     1.88     1.89     1.87     1.89
 net revenue                          ¥              0   225331   476786   772450   844840   428870  -274963  -546202  -573158  -619107  -520715  -410742  -246071  -229856
 net revenue, ph                      ¥/hd           0   193.09   204.21   225.62   187.12    95.24   -61.03  -107.26  -115.20  -123.49  -101.77   -76.77   -46.47   -42.97

SUBSYSTEM 4.2
 sales to SYS4.3                      ¥              0        0   139112   320043   640761  1123531  1772762  2126072  2191076  2247966  2306390  2366308  2411069  2437670
 cattle purchase SYS3                 ¥              0        0    74265   170706   373540   663066  1062432  1290697  1340736  1380949  1422797  1465905  1499163  1515945
 silage                               ¥              0        0    32773    72277   152663   256650   396610   460276   477609   487291   497806   507077   514373   519517
 VET & OTHER                          ¥              0        0     6173    13615    26567    44559    68657    81298    82932    84599    86200    88034    89301    90194
 yardage                              ¥              0        0     7408    16337    31869    53470    82629    97550    99519   101519   103560   105641   107161   108233
 labor                                ¥              0        0      568     1253     2449     4102     6339     7404     7634     7790     7944     8104     8221     8302
 Total costs                          ¥              0        0   121188   281388   586987  1021790  1617075  1945313  2008110  2062146  2117602  2174762  2218218  2241151
 costs/gain                           ¥/kg           0        0     2.64     2.64     2.80     2.80     2.80     2.80     2.80     2.80     2.80     2.80     2.80     2.80
 net revenue                          ¥              0        0    17924    38655    61775   101741   154080   180759   182966   185820   188707   191626   193650   195479
 net revenue, ph                      ¥/hd           0        0      145      142      117      114      112      111      110      110      109      109      108      108

SUBSYSTEM 4.3
 sales to SYS4.4                      ¥              0        0   170379   416624   850931  1400104  2365362  2854730  2957404  3045001  3120037  3213069  3280101  3322510
 yS purchase cost                     ¥              0        0   139112   320043   640761  1123531  1772762  2126072  2191076  2247966  2306390  2366308  2411069  2437670
 VET & OTHER                          ¥              0        0     1227     2700     5276     8873    13716    16199    16527    16862    17203    17549    17801    17979
 labor                                ¥              0        0      282      623     1214     2042     3157     3720     3804     3881     3959     4039     4097     4130
 pasture fr SYS1.2                    ¥              0        0     6476    14297    27856    46848    72421    85529    87265    89032    90831    92659    93992    94932
 Total costs                          ¥              0        0   147097   338470   683107  1181294  1862056  2231527  2298671  2357741  2418382  2480624  2527759  2554719
 costs/gain                           ¥/kg           0        0     0.78     0.70     0.65     0.61     0.58     0.56     0.54     0.53     0.53     0.52     0.52     0.51
 net revenue                          ¥              0        0    31282    78154   167824   306810   503307   623210   658732   688140   710455   733234   752422   768791
 net revenue, ph                      ¥/hd           0        0      255      289      318      346      367      385      399      408      413      418      423      428

SUBSYSTEM 4.4
 sales to SYS5                        ¥              0        0   236798   524632  1024429  1725225  2669068  3153869  3210918  3284723  3351515  3419310  3468795  3503643
 cattle purchase cost                 ¥              0        0   170379   416624   850931  1400104  2365362  2854730  2957404  3045001  3120037  3213069  3280101  3323510
 silage                               ¥              0        0    31949    55256    89632   119196   145136   144181   122263   109398   100941    92193    87151    82402
 supp                                 ¥              0        0    10903    18857    26765    35593    43339    43054    36509    32668    30142    27530    26024    24696
 VET & OTHER                          ¥              0        0     1214     2690     5253     8847    13688    16174    16507    16845    17187    17535    17789    17967
 yardage                              ¥              0        0     5912     9213    13659    17390    21174    20025    16981    15194    14920    12805    11639    11065
 labor                                ¥              0        0      423      707     1047     1334     1624     1536     1303     1166     1075      982      893      844
 Total costs                          ¥              0        0   228381   516709  1003606  1695245  2629237  3128648  3203564  3276448  3349746  3424767  3485656  3523312
 costs/gain                           ¥/kg           0        0     3.24     3.53     3.36     3.35     3.33     3.52     3.62     3.72     3.82     3.95     4.19     4.27
 net revenue                          ¥              0        0     8417     7923    20823    29980    39831    25221    15354     8275     1769    -5458   -16656   -19669
 net revenue, ph                      ¥/hd           0        0       69       29       40       34       29       16        9        5        1       -3       -9      -11

COMPONENT 4
 total revenue(sales outside system)  ¥              0   875521  2261241  3786999  6009221  6655762  7790436  8976277  9066199  9152020  9474073  9865649 10180045 10360670
 total costs                          ¥              0   650190  1726831  2889810  4833959  5788301  7367367  8693368  8790305  8888891  9093857  9346988  9505499  9645933
 costs/gain                           ¥/kg           0     2.34     2.19     2.08     2.10     2.05     2.01     2.01     1.96     1.92     1.91     1.91     1.90     1.91
 NET REVENUE                          ¥              0   225331   534410   897189  1175262   867461   423063   282908   275895   263129   380217   518661   683346   714745
 NET REVENUE, ph                      ¥/hd           0      194      190      212      180      121       49       28       28       26       37       49       64       67

CAPITAL COSTS:
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FEEDLOT
 land                                 ¥         200000                                0
 MACHINERY                            ¥         600000                           400000
 facilities                           ¥         750000                           250000
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TOTAL CAPITAL COSTS, COMP 4          Y       1550000       0       0       0  650000       0       0       0       0       0       0       0       0       0
CASH FLOW INC CAP EXP                Y      -1550000  225331  534410  897189  525262  867461  423063  282908  275895  263129  384217  518661  683346  714745
IRR - COMPONENT 4                          Guess:      0.30
                                           Actual:     0.32
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COMPONENT 5: SLAUGHTER/PRIMARY PROCESSING

TECHNOLOGICAL COEFFICIENTS:

COEFFICIENT OR ITEM	UNITS	YEAR 1	YEAR2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15
SUBSYSTEM 5.11																
sltr	hd	0	350	835	1405	2125	3061	3468	3393	3317	3240	3162	3084	3005	3000	3000
LW, avg	kg	0	495	500	520	543	553	559	564	569	574	580	585	587	587	587
DI	%	0	52.64	54.12	55.14	55.66	56.18	56.71	57.24	57.34	57.34	57.34	57.34	57.34	57.34	57.34
FI	%	0	43.24	44.46	45.30	45.72	46.15	46.58	47.02	47.46	47.91	47.94	47.94	47.94	47.94	47.94
WI	%	0	31.00	30.11	29.16	28.34	28.24	27.94	27.64	27.35	27.06	26.77	26.50	26.50	26.50	26.50
BPI	%	0	20.84	24.01	25.99	27.12	27.95	28.77	29.60	29.99	30.28	30.57	30.84	30.84	30.84	30.84
LB, ph	mhr/hd	0	4.24	3.57	3.15	2.85	2.61	2.41	2.29	2.19	2.12	2.12	2.12	2.12	2.12	2.12
LB, total	mm	0	7	15	22	30	40	42	39	36	34	34	33	32	32	32
SUBSYSTEM 5.12																
sltr, yB & yS	hd	0	0	238	531	1040	1756	2721	3218	3286	3354	3423	3493	3544	3579	3582
sltr, cB	hd	0	0	4	40	64	95	110	110	110	110	110	110	110	110	110
LW, yB & yS	kg	0	500	500	500	500	500	500	500	500	500	500	500	500	500	500
LW, cB	kg	0	563	591	614	633	645	652	658	665	672	678	685	688	688	688
DI	%	0	56.00	57.68	58.83	59.42	60.02	60.62	61.00	61.00	61.00	61.00	61.00	61.00	61.00	61.00
FI	%	0	46.00	47.38	48.73	48.81	49.30	49.79	50.29	50.79	51.00	51.00	51.00	51.00	51.00	51.00
WI	%	0	30.00	28.50	27.65	27.09	26.82	26.55	26.29	26.02	25.76	25.51	25.25	25.00	25.00	25.00
BPI	%	0	26.00	29.18	31.19	32.33	33.19	34.06	34.71	34.98	35.24	35.49	35.75	36.00	36.00	36.00
LB, ph	mhr/hd	0	4.00	3.40	3.03	2.75	2.53	2.36	2.20	2.15	2.08	2.04	2.02	2.00	2.00	2.00
LB, total	mm	0	10	9	8	7	6	6	6	5	5	5	5	5	5	5
SUBSYSTEM 5.2																
YIELD, DRY BEEF	%	0	45.00	46.35	47.28	47.75	48.23	48.71	49.20	49.69	50.00	50.00	50.00	50.00	50.00	50.00
input beef	kg	0	91199	230900	420698	661829	981827	1134291	1131447	1119449	1104762	1089252	1073053	1049458	1047753	1047753
output, dry beef	kg	0	41039	107022	198893	316022	473500	552500	556634	556238	552381	544626	536527	524729	523876	523876
LB, ph	mhr/hd	0	8.00	7.20	6.62	6.16	5.79	5.50	5.28	5.12	5.02	5.00	5.00	5.00	5.00	5.00
LB, total	mm	0	14	30	47	65	89	95	90	85	81	79	77	75	75	75
SYSTEM 5																
LB, fixed	mm	0	60	60	60	60	60	60	60	60	60	60	60	60	60	60
LB, var	mm	0	31	53	76	103	135	143	134	127	121	118	115	112	112	112
TB	mm	0	36	36	36	36	36	36	36	36	36	36	36	36	36	36
OB	mm	0	36	36	36	36	36	36	36	36	36	36	36	36	36	36
electricity rqmt	kwhr	0	103500	110768	119749	132205	149123	162995	167218	167131	167044	166957	166870	166506	166894	166919
total sltr	hd	0	350	1077	1975	3229	4912	6299	6721	6713	6704	6696	6687	6659	6689	6692

FINANCIAL INFORMATION:

COEFFICIENT OR ITEM	UNITS	YEAR 1	YEAR2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15
REVENUE:																
price, boxed beef	Y/kg	0	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
price, dry beef	Y/kg	0	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
price, EBP	Y/kg	0	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
price, IBP	Y/kg	0	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
price, blood meal	Y/kg	0	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
price, hide	Y/kg	0	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
price, bone meal	Y/kg	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SUBSYSTEM 5.11																
revenue, EBP	Y	0	38127	107640	203501	330479	499855	586624	598003	597807	595102	591795	587628	574149	573180	573180
revenue, IBP	Y	0	12619	35625	67352	109377	165435	194814	197918	197834	196958	195864	194485	190024	189703	189703
revenue, blood	Y	0	6716	18959	35804	58299	88043	103678	105330	105296	104819	104237	103503	101120	100958	100958
revenue, hide	Y	0	25274	71352	134897	219868	331343	390186	396403	396274	394480	392288	389526	380591	379949	379949
revenue, bone meal	Y	0	6860	19367	36615	59461	89936	105908	107595	107560	107073	106478	105729	103303	103129	103129
Total Revenue	Y	0	89595	252944	478208	776595	1174611	1383210	1405249	1404798	1398433	1390662	1380871	1349195	1346918	1346918
Total Revenue, ph	Y/hd	0	256	303	340	365	384	399	414	424	432	440	448	449	449	449
SUBSYSTEM 5.12																
REVENUE, BOXED BEEF	Y	0	0	281769	641323	1270030	2165540	3388719	4047900	4174089	4270892	4366753	4455628	4520375	4565900	4569146
revenue, EBP	Y	0	0	37361	298882	521743	829166	1103797	1214369	1231684	1246652	1261294	1275371	1276403	1282310	1282782
revenue, IBP	Y	0	0	14010	112081	195654	310937	413924	455388	461081	467495	472985	478264	478681	480866	481043
revenue, blood	Y	0	0	6581	52644	91898	146046	194419	213895	216944	219581	222160	224639	224835	225861	225945
revenue, hide	Y	0	0	24766	198123	345852	549637	731684	804979	816457	826379	836085	845416	846153	850016	850329
revenue, bone meal	Y	0	0	6793	17342	34775	59875	93668	112067	115250	118464	121727	125044	127697	128933	129019
Total Revenue	Y	0	0	371279	1320395	2459960	4061201	5926210	6848578	7017186	7157462	7281064	7404362	7474224	7533967	7538262
Total Revenue, ph	Y/hd	0	0	1536	2316	2229	2194	2093	2058	2066	2066	2061	2055	2046	2042	2042
SUBSYSTEM 5.2																
REVENUE, DRY BEEF	Y	0	615674	1605546	2983796	4740961	7103572	8288722	8350624	8344689	8286819	8170479	8048971	7871987	7859193	7859193
Revenue, ph	Y/hd	0	1759	1923	2124	2231	2321	2390	2461	2516	2558	2584	2610	2620	2620	2620
TOTAL REVENUE, COMP 5	Y	0	705269	2229769	4782400	7977516	12339384	15598143	16604472	16766585	16842715	16842145	16834204	16695406	16740079	16744374

TOTAL REVENUE, COMP 5, ph	$/hd		0	2015	2071	2422	2471	2512	2476	2471	2498	2512	2513	2517	2507	2502	2502
OPERATING EXPENSES:																
price, electricity	$/kwhr		0	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
price, VAR INPUTS	$/hd		0	100	100	100	100	100	100	100	100	100	100	100	100	100	100
COSTS:																
	$		0	389036	1913117	3628780	6088095	9391008	12136030	13025353	13074309	13119551	13162173	13202763	13161435	13221030	13409440
personnel (fixed component)	$		0	21720	21720	21720	21720	21720	21720	21720	21720	21720	21720	21720	21720	21720	21720
var labor	$		0	4399	7083	10670	14343	18002	20042	18757	17730	16924	16477	16079	15677	15632	15632
VAR INPUTS	$		0	33000	107677	197400	322034	491228	629926	672106	671309	670443	669571	668701	665061	668944	669192
electricity	$		0	20700	22134	23950	26457	29823	32599	33442	33426	33409	33391	33374	33317	33379	33380
MARKETING (10% gross rev)	$		0	70527	222977	678240	797752	1253938	1359814	1660447	1676659	1684271	1684214	1683420	1669541	1670000	1674437
Total op expenses	$		0	741396	2297126	4370856	7271243	11187401	14400131	15431825	15495152	15546319	15587567	15625557	15567551	15634741	15823826
Total op expenses, ph	$/hd		0	2118	2133	2213	2252	2277.	2286	2294	2300	2319	2328	2337	2338	2337	2365
NET REVENUE	$		0	-36126	-67350	411544	706273	1151983	1190012	1172647	1271433	1296396	1254597	1208648	1127835	1105337	920548
NET REVENUE, ph	$/hd		0	-103	-63	208	219	235	190	174	189	193	187	181	169	165	138
CAPITAL COSTS:																
sltr plant	$	175000														
SLTR/PROCESSING EQPT	$	250000														
freezer annex	$	200000														
freezer eqpt	$	250000														
EXPANSION & UPGRADING	$	0					525000										
VEHICLES	$	200000								200000							
reefer cars	$	100000															
OTHER EQPT	$	100000															
land (1ha)	$	4500															
TOTAL CAPITAL COSTS, COMP 5	$	1279500		0	0	0	525000	0	0	200000	0	0	0	0	0	0	0
CASH FLOW INC CAPITAL EXP	$	-1279500		-36126	-67350	411544	181273	1151983	1190012	972647	1271433	1296396	1254597	1208648	1127835	1105337	920548

IRR - COMPONENT 5 Guess: 0.30
Actual: 0.32

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COMPONENT 6: SYSTEM HEADQUARTERS
********************************
                                       UNITS    YEAR 1    YEAR2   YEAR 3   YEAR 4   YEAR 5   YEAR 6   YEAR 7   YEAR 8   YEAR 9  YEAR 10  YEAR 11  YEAR 12  YEAR 13  YEAR 14  YEAR 15

LR                                      mm          48       48       48       48       48       48       48       48       48       48       48       48       48       48       48
HR                                      mm          24       24       24       24       24       24       24       24       24       24       24       24       24       24       24

COMPONENT REVENUE:
******************
GOVERNMENT GRANTS AND SUBSIDIES         Y            0        0        0        0        0        0        0        0        0        0        0        0        0        0        0

POOLED OPERATING COSTS:
***********************
TRAINING AND TECH TRANSFER PROGRAM      Y       500000   500000   500000   500000   500000   500000   500000   100000   100000   100000   100000   100000   100000   100000        0
CANADIAN STAFF                          Y       300000   300000   300000   300000   300000   300000   300000   300000   300000   300000   300000   300000   300000   300000   300000
CANADA OFFICE                           Y       150000   150000   150000   150000   150000   150000   150000   150000   150000   150000   150000   150000   150000   150000   150000
SF office and administration            Y        50000    50000    50000    50000    50000    50000    50000    50000    50000    50000    50000    50000    50000    50000    50000
management                              Y         4800     4800     4800     4800     4800     4800     4800     4800     4800     4800     4800     4800     4800     4800     4800
labor                                   Y         6720     6720     6720     6720     6720     6720     6720     6720     6720     6720     6720     6720     6720     6720     6720
TRAVEL & MISC.                          Y       100000   100000   100000   100000   100000   100000   100000   100000   100000   100000   100000   100000   100000   100000   100000
PROMOTIONAL AND SETUP                   Y       200000
Total                                   Y      1311520  1111520  1111520  1111520  1111520  1111520  1111520   711520   711520   711520   711520   711520   711520   711520   611520

POOLED CAPITAL COSTS:
*********************
SF office & eqpt (inc the land)         Y       100000        0        0        0        0        0        0        0        0        0        0        0        0        0        0
COMPUTING SYSTEM                        Y       150000        0        0        0        0        0        0        0    75000        0        0        0        0        0        0
accom/facilities for staff              Y       250000        0        0        0        0        0        0        0        0        0        0        0        0        0        0
boiler plant, backup power generator    Y      1000000        0        0        0        0        0        0        0        0        0        0        0        0        0        0
VEHICLES & MISC.                        Y       150000        0        0        0        0        0        0        0   150000        0        0        0        0        0        0
TOTAL CAPITAL COSTS, COMPONENT 6        Y      1650000        0        0        0        0        0        0        0        0        0        0        0        0        0        0

FINANCIAL SUMMARY:
******************
TOTAL SALES OUTSIDE SYSTEM              Y            0   705269  2229769  4782400  7977516 12339304 15598143 16604472 16766585 16842715 16961422 17139217 17165919 17265814 17277394
TOTAL EXPENSES, OUTSIDE SYSTEM          Y      1650204  2327879  3683610  5201017  7076958  8270901  8931059  8827946  8647308  8587352  8568974  8547034  8507828  8577246  8350741
NET REVENUE, PROJECT                    Y     -1650204 -1622610 -1453841  -418617   900558  4068403  6667084  7776526  8119277  8255363  8392448  8592183  8658091  8688567  8926653
OUT OF SYSTEM CAPITAL COSTS, PROJECT    Y      7381400   337902   732339   521796  2749513   178306    36000   205000     5000     5000     5000     5000     5000     5000     5000
CASH FLOW INC CAPITAL EXP, PROJECT      Y     -9031604 -1960512 -2186180  -940413 -1848955  3890097  6631084  7571526  8114277  8250363  8387448  8587183  8653091  8683567 20171653
==================================================================================================
IRR, PROJECT                                  Guess:      0.20
                                              Actual:     0.22
==================================================================================================
COMPONENT 7: JV CONSIDERATIONS
******************************
LABOR USE:                     UNITS     YEAR 1-   YEAR2   YEAR 3   YEAR 4   YEAR 5   YEAR 6   YEAR 7   YEAR 8   YEAR 9  YEAR 10  YEAR 11  YEAR 12  YEAR 13  YEAR 14  YEAR 15
**********
LABOR RQMT, PROJECT            man years      22       60       88      129      184      248      279      280      279      279      279      279      279      279      279
TECH RQMT, PROJECT             man years      15       19       25       34       47       63       71       71       71       71       71       71       71       71       71
MGMT RQMT, PROJECT             man years       8       12       12       12       13       15       16       16       16       16       16       16       16       16       16
TOTAL EMPLOYMENT               man years      45       91      125      175      244      327      367      368      367      366      366      366      366      366      366

FINANCIAL EFFICIENCY:
*********************
TOTAL OUTPUT/EMPLOYEE          Y/emp           0     7756    17820    27272    32693    37729    42554    45136    45709    46010    46335    46817    46900    47159    47198
TOTAL OUTPUT/MU                Y/mu            0       22       36       50       59       72       87       92       94       96       97       98       99       99      383
TOTAL OUTPUT/HA                Y/ha            0      323      538      746      882     1084     1306     1381     1416     1436     1454     1473     1470     1485     8746
TOTAL OUTPUT/HEAD              Y/hd            0      705     1115     1528     1585     1428     1560     1640     1677     1684     1696     1714     1717     1727     1728

NET REVENUE/EMPLOYEE           Y/emp      -37683   -17844   -11619    -2387     3691    12440    18189    21139    22135    22552    22926    23470    23655    23732    24386
NET REVENUE/MU                 Y/mu          -50      -50      -23       -4        7       24       37       43       46       47       48       49       50       50       51
NET REVENUE/HA                 Y/ha         -755     -743     -351      -65      100      350      558      647      686      704      720      730      746      747      769
NET REVENUE/HEAD               Y/hd            0    -1623     -727     -116      156      471      667      778      812      826      839      859      866      869      893

FOREIGN CURRENCY:
*****************
OPERATING EXP FOR CUR RQMT     Y         1250000  1320741  1736902  2309187  3060332  3887027  4485305  4280492  4281980  4281609  4282962  4287016  4274016  4286836  4185638
FOR CUR GENERATION             Y               0   615674  1887315  3625119  6010998  9269112 11677441 12398524 12519570 12565711 12537232 12504599 12392361 12425174 12428339
FOR CUR SALES/TOTAL SALES      %               0     0.87     0.85     0.76     0.75     0.75     0.73     0.75     0.75     0.75     0.74     0.73     0.72     0.72     0.72
NET FOREIGN CURRENCY BALANCE   Y        -1250000  -705067   150413  1315932  2950666  5382085  7192136  8118032  8237590  8284102  8254270  8217583  8118345  8138338  8242701

EQUITY SHARE:
*************
FOREIGN CAPITAL RQMT           $          884615        0   115385        0   451923        0        0    76923    86538        0        0        0        0        0        0
FOREIGN CAPITAL RQMT           Y         2300000        0   300000        0  1175000        0        0   200000   225000        0        0        0        0        0        0
TOTAL CAPITAL RQMT             Y         7381400   337902   732339   521796  2749513   178586    36000   205000     5000     5000     5000     5000     5000     5000     5000
DISCOUNT RATE                               0.15
NPV FOR CAP                    Y         2910777        $  1119530
NPV TOTAL CAP                  Y         8985438        $  3455958
MIN FOR PARTNER EQUITY SHARE   %              32
PROBABLE FOR PARTNER EQUITY SHARE %           35

RETURN TO FOREIGN PARTNER:
**************************
EXCHANGE RATE                  Y/$          2.60     2.60     2.60     2.60     2.60     2.60     2.60     2.60     2.60     2.60     2.60     2.60     2.60     2.60     2.60
NET CASH FLOW, FOREIGN PARTNER Y        -2834573  -525634  -770963  -135608  -883270  1317960  2159760  2319157  2405189  2674274  2718681  2783384  2804735  2814607  2891734
ABOVE IN CANADIAN FUNDS        $        -1090221  -202167  -296524   -52157  -339719   506908   830677   891984   925073  1028567  1045647  1070532  1078744  1082541  1112205
IRR, FOREIGN PARTNER                   Guess:      0.20
                                       Actual:     0.21

RETURN TO CHINESE PARTNER:
**************************
NET RETURN TO CHINESE PARTNER  Y        -6197031 -1960512 -1886180  -940413  -673955  3896097  6631064  7771526  8359277  8250363  8367448  8387183  8453091  8483567  8921653
IRR, CHINESE PARTNER                   Guess:      0.20
                                       Actual:     0.26
**********************************************************************************
```

```
          KEY OUTPUT             SCENARIO:A
                                 RUN:          0

==========================================================================
IRR - COMPONENT 1                                  Guess:       0.30
                                                   Actual:      0.31
==========================================================================
IRR - COMPONENT 2                                  Guess:       0.30
                                                   Actual:      0.31
==========================================================================
IRR - COMPONENT 3                                  Guess:       0.30
                                                   Actual:      0.32
==========================================================================
IRR - COMPONENT 4                                  Guess:       0.30
                                                   Actual:      0.32
==========================================================================
IRR - COMPONENT 5                                  Guess:       0.30
                                                   Actual:      0.32
==========================================================================
IRR, PROJECT                                       Guess:       0.20
                                                   Actual:      0.22
==========================================================================
```